SCHOOL OF
CIVIL ENGINEERING

INDIANA
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JOINT HIGHWAY RESEARCH PROJECT

Interim Report

FHWA/IN/JHRP-85/1

EMBARK-TELAR-SURFACTANT-2,4-D COMBINATIONS FOR VEGETATION MANAGEMENT ALONG INDIANA ROADSIDES

D. James Morre

PURDUE UNIVERSITY

JOINT HIGHWAY RESEARCH PROJECT

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TO: H. L. Michael, Director
Joint Highway Research Project

FROM: D. J. Morre

January 30, 1985

Project: C-36-53K

File: 9-5-11

Attached is an Interim Report of the HPR Part II study titled "Cost Reduction and Increased Efficacy of Growth Retardant Mixtures for Vegetation Management Along Indiana Roadsides." I serve as the principal investigator on this study, direct the project and have authored the report.

The research results include recommendations for a single spray application that will control weeds and retard grass growth so that no further herbicide application or mechanical mowing is required for the year within the interstate system. The present recommendations and the experimental data upon which those recommendations are based involve new combinations of materials where costs of materials have now been reduced to the point where the cost of the spray application is competitive with a single mechanical mowing cycle.

The results of this study have been recommended for implementation in the State of Indiana and point the way to even greater cost saving modifications in the program of chemical mowing for future years.

Sincerely

D. J. Morre

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Interim Summary Report

EMBARK-TELAR-SURFACTANT-2,4-D COMBINATIONS FOR VEGETATION MANAGEMENT ALONG INDIANA ROADSIDES

by

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and the

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Federal Highway Administration

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

Purdue University
West lafayette, Indiana
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16. Abstract Using a combination of a primary growth retardant, mefluidide, a synergistic additive, chlorsulfuron, a detergent to enhance penetration (X-77) and a herbicide, 2,4-D, to provide for control of broadleaf weeds, full season management of bluegrass-tall fescue mixtures along roadsides has been achieved. A single spray application is made in the spring and no additional herbicide applications or mechanical mowing are needed. The treatment is effective with greater than 90% control of fescue seedheads. Those few seedheads that do form remain short. It is economical. The costs of materials and application are equal to or less than the cost of a single mowing cycle. The treatment is environmentally safe when applied in early spring before most agricultural crops have been planted. The effectiveness and low cost of the combination derives from laboratory and greenhouse observations that various materials, herein referred to as additives, often only weakly effective as growth retardants themselves, will interact synergistically with mefluidide to provide overall treatment effectiveness at application rates that are economical. Using this principle, a combination suitable for roadside vegetation management was devised, field tested for two years under actual use conditions, and found to be effective for full season vegetation management of mixed bluegrass-tall fescue turf to permit considerable cost savings when compared to 3-cycle mechanical mowing.

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TABLE OF CONTENTS

	Page
LIST OF FIGURES	iii
LIST OF TABLES	iv
ABSTRACT	1
INTRODUCTION	2
MATERIALS AND METHODS	3
Greenhouse studies	3
Field trials	3
RESULTS	4
Effect of surfacant	4
Effect of additives	8
Setting the rate of clorsulfuron	8
Setting the rate of melfluidide	14
Environmental safety	16
Implementation tests, 1982-1984	20
DISCUSSION	20
REFERENCES	25
APPENDIX I, 1983 Summary	27
APPENDIX II, 1984 Summary	89

LIST OF FIGURES

Figure		page
1	Effect of rate of application of surfactant XM-12 on growth of mowed bluegrass in the field in the presence of 1/2 lb/A mefluidide plus 2 lb/A of 2,4-D amine (acid equivalent).	7
2	Influence of application amount of mefluidide on seedhead formation in fescue	9
3	Enhancement of mefluidide by different rates of additive K-104 compared to no additive	10
4	Influence of application amount of chlorsulfuron on seedhead formation in fesuce	12
5	Growth suppression of fescue by the combination of 1/4 lb/A mefludide + 1/4 oz/A chlorsulfuron (Telar) + 2 lb/A 2,4-D amine with X-77 surfactant as 0.5% of the total spray mixture compared to the same conditions of 2,4-D and surfactant but with 1/2 lb/A of mefluidide instead	19

LIST OF TABLES

Table		Page
1	Enhancement by surfactants of foliar penetration of mefluidide into Kentucky bluegrass in the greenhouse	5
2	Fescue seedhead suppression from mefluidide and mefludide plus surfactant with and without 2,4-D	6
3	Retardation of Kentucky bluegrass	11
4	Effect of varying concentrations of chlorsurlfuron on the control of wild carrot under roadside conditions	13
5	Comparisons of different rates of 2,4-D amine on mefluidide-2,4-D antagonism under roadside conditions	15
6	Summary of comparisons of Schedule A, Schedule B and Schedule C on seedhead formation in fescue and bluegrass comparing all 1984 dates of application	17
7	Comparison of Schedule A, Schedule B, and Schedule C on root lengths of fescue and bluegrass	18
8	Tests under roadside use conditions of mefluidide (1/2 lb/A) + surfactant (0,5%) + 2,4-D amine (2 lb/A)	21
9	Evaluation of a spring application of 1/4 lb/A mefluidide + 1/4 oz/A chlorsurlfuron + 2 lb/A 2,4-D amine + 0.25% (by volume of total spray mixture) applied by the Indiana Department of Highways under actual use conditions	22

Abstract. Using a combination of a primary growth retardant, mefluidide, a synergistic additive, chlorsulfuron, a detergent to enhance penetration (X-77) and a herbicide, 2,4-D, to provide for control of broadleaf weeds, full season management of bluegrass-tall fescue mixtures along roadsides has been achieved. A single spray application is made in the spring and no additional herbicide applications or mechanical mowing are needed. The treatment is effective with greater than 90% control of fescue seedheads. Those few seedheads that do form remain short. It is economical. The costs of materials and application are equal to or less than the cost of a single mowing cycle. The treatment is environmentally safe when applied in early spring before most agricultural crops have been planted. The effectiveness and low cost of the combination derives from laboratory and greenhouse observations that various materials, herein referred to as additives, often only weakly effective as growth retardants themselves, will interact synergistically with mefluidide to provide overall treatment effectiveness at application rates that are economical. Using this principle, a combination suitable for roadside vegetation management was devised, field tested for two years under actual use conditions, and found to be effective for full season vegetation management of mixed bluegrass-tall fescue turf to permit considerable cost savings when compared to 3-cycle mechanical mowing.

Introduction

Mechanical mowing of roadsides as required by current safety and esthetic standards is a costly maintenance item. At current estimates of $20-25 per acre per mowing cycle, annual mowing costs would be $60-75 per acre for the 3 cycles of mechanical mowing normally required in the midwestern United States to maintain adequate site distances and visual appearances. In a state such as Indiana, where approximately 60-70,000 acres of roadside are mowed each year, the annual costs for mowing may well exceed $5,000,000 annually.

In 1977, a research project was initiated to develop a growth retardant mixture that would reduce or prevent growth of grass and weeds so that the need for mechanical mowing along roadsides could be eliminated or reduced. Ideally, the treatment was to consist of a single spray application. The treatment was to be effective against both fescue and bluegrass as well as give control of broadleaf weeds and brush. Maximum grass height should not exceed acceptable mowing limits any time during the entire growing season. In addition, it was important that the treatment be environmentally safe. There should be no permanent weakening of the root system of the grass, no injury to desirable species and no carry over that would limit repeated use on an annual basis. A healthy lawn-type appearance to the turf was most desirable and the treatment should be competitive with 3-cycle mechanical mowing. The most important criterion, however, was the requirement to prevent emergence of seedheads of fescue. If even a few seedheads form, the appearance can be unsightly. For any treatment, elimination of seedheads was an essential requirement.

The approach followed was to identify an effective primary retardant and then use various additives to interact synergistically with the primary retardant to increase both efficacy and cost effectiveness. 2,4-D amine salt was included for control of brush and broadleaf weeds. In this manner, full-season

vegetation management through a single spray application was realized for about the same cost or less than the cost to mow once.

Materials and Methods

Greenhouse studies.

Seeds of Kentucky bluegrass, var. Parade were germinated over a mixture of calcined clay and pasteurized soil contained in 524 ml polystyrene cups with perforated bottoms and covered with a thin layer of vermiculite. Watering and fertilizer feeding were done by bottom irrigation. Treatments were applied 3 weeks after seeding using a Beltsville sprayer equipped with a TX-6 TeeJet nozzle operated at 40 psi with the conveyer belt moving at 0.5 mph (555.6 l/ha). Seven days after spraying, the grass was cut 4 cm above the soil level. Two weeks later, the regrowth was again cut and the clippings were weighed to the nearest 0.1 g. Each treatment was replicated 5 times. Data were analyzed by a one way analysis of variance for significance and by the Colby method (1967) to test for synergism.

Field trials.

All of the field tests were under roadside conditions. Large scale tests were applied in Miami county Indiana on April 4, 1983 using truck mounted equipment provided by commercial applicators contracted by the State of Indiana and coordinated by Mr. John Burkhardt, Indiana Department of Highways. A segment of highway I-70 between Indianapolis and the Illinois State Line was treated also using truck mounted equipment in the spring of 1984. Applications were at 25 gpa in the 1984 tests using a Swinglok applicator system.

All other tests were located in Tippecanoe County, Indiana. Applications were with a hand held compressed air sprayer, spraying systems 8004 nozzles, 40 psi and 40 gpa. Plots were located either adjacent to the pavement or adjacent to the fence in mixed stands of fescue and bluegrass unless indicated otherwise.

Except where indicated, all grass was unmowed at the time of application. Plots were 3 ft X 6 ft or 6 ft X 15 ft and in triplicate. Seedheads were counted in 3 1 ft squares in 3 different regions in each plot. Seedhead height was an average of "maximum" seedhead height in 3 different areas of each plot and is expressed in inches. Blade height is the maximum extended blade height (soil to tip) in inches of the lower blades originating at the base of the grass clump from 3 different areas of each plot.

Amounts of all herbicides and retardants are reported as active ingredient: Embark^R = lb/A as mefluidide (N-[2,4-dimethyl-5-[(trifluoromethyl) sulfonyl] amino]phenyl]acetamide); Telar^R or Glean^R = oz/A of chlorsulfuron (2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2yl)aminocarbonyl]benzenesulfonamide); 2,4-D amine = lb/A of acid equivalent of the dimenthylamine salt or 2,4-dichlorophenoxyacetic acid. Surfactants were given as % of the total spray mixture. Surfactant XM-12 ^{R} is a product of Witco Chemical Corporation, Houston, TX (also known as Sponto-H3A^R). Surfactant X-77 ^{R} was from Ortho. Surfactant WK ^{R} was from DuPont.

Results

Effect of surfactant.

Surfactants greatly enhanced the effectiveness of mefluidide both in the greenhouse (Table 1) and in the field (Table 2). With mowed bluegrass in the field and the surfactant XM-12, the optimum concentration was between 0.25 and 0.5% for enhancement of the action of 1/2 lb/A mefluidide in suppression of blade elongation (Fig. 1). Some surfactants were more effective than others but in the field these differences tended to be minimized with time from date of treatment so that in the end the choice of surfactant was not critical. With mefluidide alone at various rates, the overall effect of surfactant was to about

Table 1. Enhancement by surfactants of foliar penetration of mefluidide into Kentucky bluegrass in the greenhouse

Surfactants *	Clipping weights of regrowth ** 1st cut 7 days after spraying (g/pot)
None	8.9 ab
XM-12, 0.5%	1.1 e
X-77, 0.5%	2.7 d
Checks	9.8 a

* All treatments except the checks contained mefluidide at 0.216/A. Means followed by the same letter are not significantly different at the 95% confidence interval.

** Two weeks of regrowth after 1st cut.

Table 2. Fescue seed head suppression from mefluidide and mefluidide plus surfactant with and without 2,4-D amine

Treatment (Rate per acre)	Seedheads per ft^2	Suppression %
None (check)	18	0
Mefluidide (1/2 lb/A)	9	50
Mefluidide (1/2 lb/A) + Surfactant (1%)	4	75
Mefluidide (1/2 lb/A) + 2,4-D amine (2 lb/A)	13	28
Mefluidide (1/2 lb/A) + Surfactant (1%) + 2,4-D amine (2 lb/A)	2	89

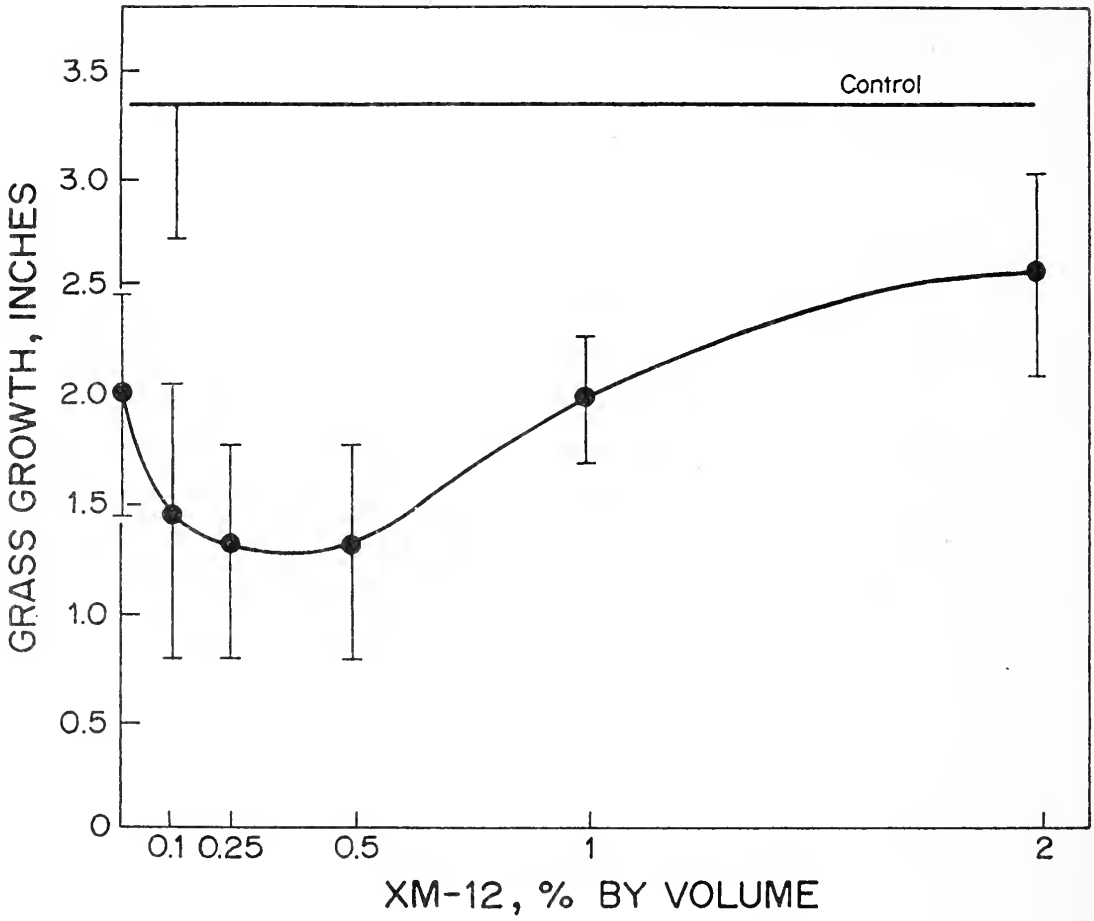

Fig. 1. Effect of rate of application of surfactant XM-12 on growth of mowed bluegrass in the field in the presence of 1/2 lb/A mefluidide plus 2 lb/A of 2,4-D amine (acid equivalent). Applications were on August 8, September 9, September 11 and September 16, 1982. Each treatment was replicated 3 times. Growth measurements were 1 month after treatment. Values are the averages of the four experiments (12 replicates total) ± standard deviations.

double the effectiveness of the primary retardant material in the control of fescue seedheads (Fig. 2), so that 90% control of fescue seedheads could be achieved at rates of mefluidide between 1/2 and 1 lb/A with added surfactant.

Effect of additives.

A second way to increase effectiveness of the primary retardant, mefluidide was through synergistic interaction with various other materials. Fig. 3 shows results with an experimental material K-104 which was itself without activity in the field but interacted with mefluidide to nearly double its effectiveness in this particular test.

As shown in Table 3 and reference 2, mefluidide is synergistic with certain herbicides especially the E. I. du Pont de Nemour material, chlorsulfuron. Mefluidide is synergistic with other plant growth regulators and herbicides such as PP-333 (paclobutrazol), EL-500 (flurprimodol), bentazon, acifluorefen, sethoxydim, naptalam, and the thiocarbamates (Rao and Harger, 1981; McWorter and Barrentine, 1979, Tautvydas, 1983).

Because of various factors, including cost, commercial availability, and control of some 2,4-D-resistant weed species such as wild carrot, the du Pont material, chlorsulfuron, was selected for further evaluation.

Setting the rate of chlorsulfuron.

Rates of chlorsulfuron of 1/2 oz per acre or greater were not considered due to phytotoxicity. There is a tendency for chlorsulfuron alone to give 25 to 50% suppression of seedheads with rates in the range of 1/8 to 1 oz/A but with no obvious strict dose dependency (Fig. 4). Both in 1983 and 1984, 1/8, 1/4 and 1/2 oz per acre of chlorsulfuron were equivalent in combination with 1/4 lb/A or 1/8 lb/A of mefluidide. Since 1/16 oz/A of chlorsulfuron was ineffective for control of wild carrot but wild carrot control was achieved at higher rates (Table 4), chlorsulfuron rates of 1/8 oz/A and 1/4 oz/A were tested in greatest detail in 1984, i.e. the dose range giving both effective control of broadleaf

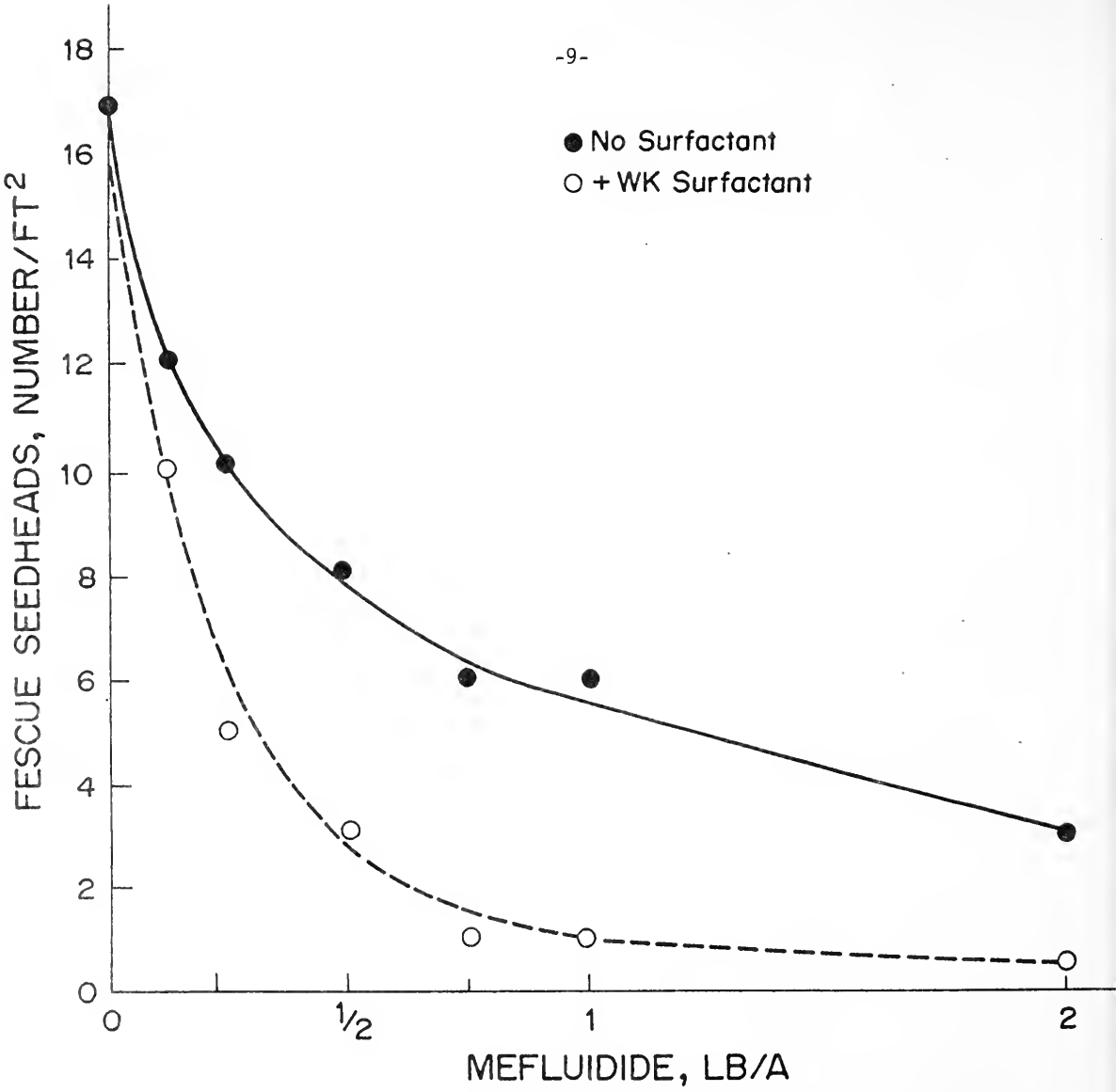

Fig. 2. Influence of application amount of mefluidide on seedhead formation in fescue. Applications were on May 3, 1983 under roadside conditions. WK surfactant was present as 0.5% of the total spray mixture. Fescue blade height was 11 ± 1 inches at the time of spraying. Evaluations were on June 22, 1983.

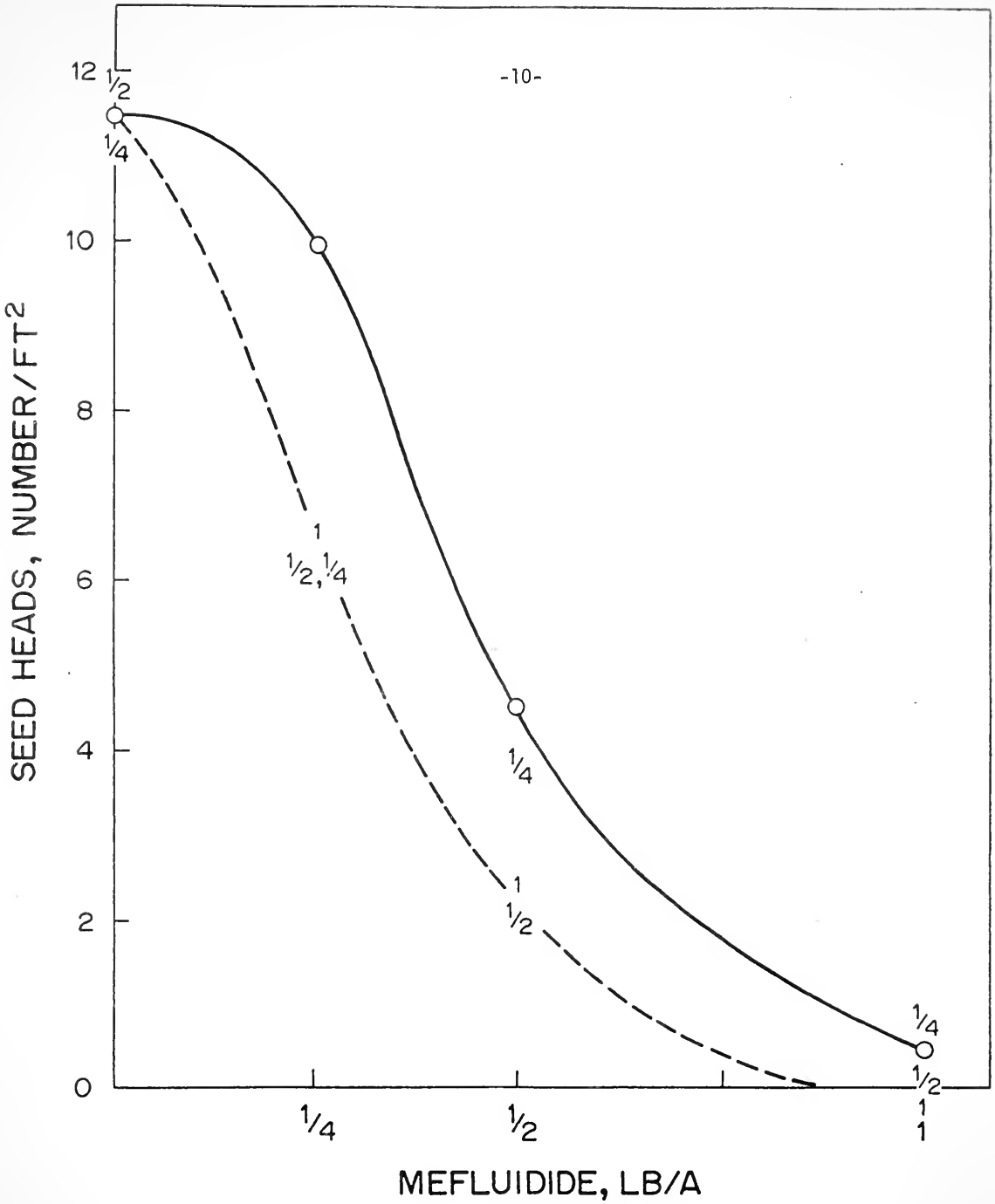

Fig. 3. Enhancement of mefluidide by different rates of additive K-104 (1/4, 1/2 or 1 lb/A) compared to no additive (0). Applications were on April 16 and 17, 1979 under roadside conditions with evaluations on June 1, 1979.

Table 3. Retardation of Kentucky bluegrass

		Clipping weight of regrowth mefluidide*				
rate	/A	0	1/32lb	1/16lb	1/8lb	1/4lb
				g/pot*		
Chlorsulfuron	0	12.7 a	11.4 a	8.6 c	4.0 d	2.0 e
	1/20 oz	10.9 b	4.7 d	2.8 de	1.2 ef	0.5 f
	1/6 oz	10.2 b	2.3 e	1.0 ef	0.1 f	0.1 f
	1/2 oz	11.4 a	1.0 ef	0.6 f	0.1 f	0.0 f
				% growth retardation*		
Chlorsulfuron	0	0.0 a	10.2 a	32.3 c	68.5 d	84.3 e
	1/20 oz	14.2 b	63.0 d (23.0)**	78.0 de (42.0)	90.6 ef (78.0)	96.0 f (86.5)
	1/6 oz	19.7 b	81.9 e (27.2)	92.1 ef (45.6)	99.2 f (74.9)	99.2 f (87.4)
	1/2 oz	10.2 a	92.1 ef (19.0)	99.3 f (39.2)	99.2 f (71.7)	100.0 f (85.9)

* Means followed by the same letter are not significantly different at the 95% confidence interval.

** Means in parentheses are the expected additive responses for the combinations as calculated by the Colby (1967) method.

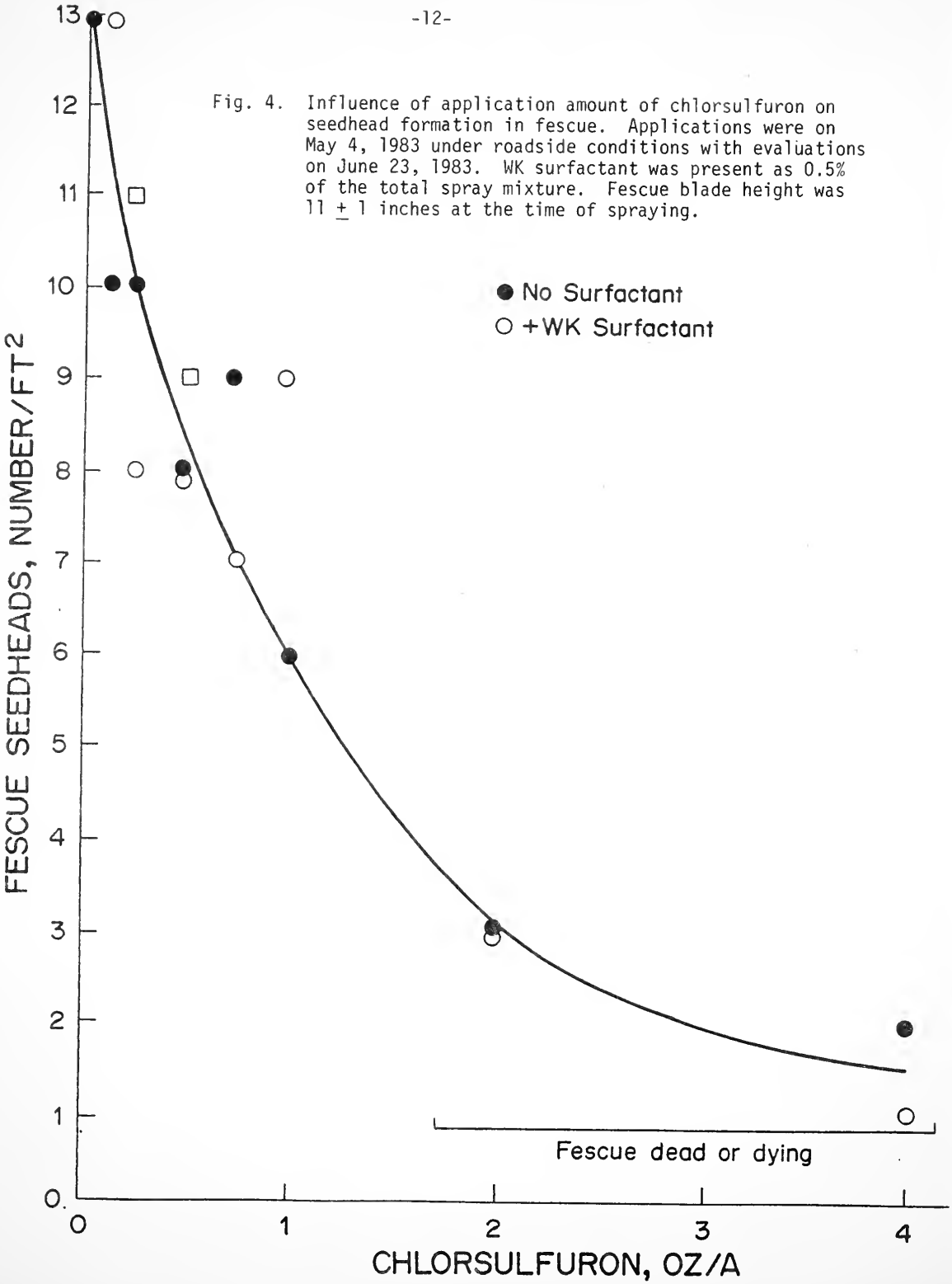

Fig. 4. Influence of application amount of chlorsulfuron on seedhead formation in fescue. Applications were on May 4, 1983 under roadside conditions with evaluations on June 23, 1983. WK surfactant was present as 0.5% of the total spray mixture. Fescue blade height was 11 ± 1 inches at the time of spraying.

Table 4. Effect of varying concentrations of chlorsulfuron on the control of wild carrot under roadside conditions. Applications on May 19, 1983 with evaluations on June 28, 1983.

Chlorsulfuron (oz/A)	Wild carrot (plants/50 ft^2)
-	37 ± 24
1/16	24
1/8	2
3/16	4
1/4	8
1/2	2
3/4	4
1	1

weeds and no persistent phytotoxicity.

Emphasis was on fescue seedhead formation in formulating rates of additives. Mefluidide-chlorsulfuron combinations that control seedhead formation in fescue may fail to control seedheads of bluegrass especially at late dates of application. However, the bluegrass seedheads that do form under these conditions generally are not taller than the vegetative parts of the fescue, are uniform in appearance, and are not unsightly.

Addition of 2,4-D to the basic mefluidide + chlorsulfuron combination.

While giving excellent control of wild carrot and some other species, chlorsulfuron is totally ineffective in the control of plantain, a dominant turf species, for example. Therefore, it was necessary to include a broadleaf herbicide such as 2,4-D amine. We have, however, noted frequently but not always, antagonism between mefluidide (alone or in combination with chlorsulfuron) and 2,4-D amine (Table 5). Combination of 2,4-D amine with surfactant, increased weed control and lessened the 2,4-D-mefluidide antagonism (Table 5). Maximum weed control with 2,4-D is achieved in the range of 1.5 to 2 lb/A as the acid equivalent. The mefluidide-2,4-D amine antagonism also was less at the higher 2,4-D rates (Table 5). Similar results were obtained in 1982, 1983 and 1984 regarding this latter point such that the rate of 2,4-D amine in the mixture was set at 2 lb/A. A rate of 1 lb/A of 2,4-D amine was insufficient to enhance weed control significantly considering the wide range of species encountered in a roadside situation. Ester formulations of 2,4-D were not considered due to problems with volatility and toxicity to fish when directly oversprayed to streams. Only the environmentally safe, amine formulations of 2,4-D have been recommended for general roadside applications.

Setting the rate of mefluidide.

Assuming that synergisms between mefluidide and chlorsulfuron and the interac-

Table 5. Comparisons of different rates of 2,4-D amine on mefluidide-2,4-D antagonism under roadside conditions. Applications were on May 6 (B) and 9 (A), 1982 with evaluations on May 26 (B) and June 7 (A). Values at ± standard deviations.

Treatment and amount			Seedheads per ft^2		Seedhead height	
Mefluidide	XM-12*	2,4-D Amine	Fescue	Bluegrass	Fescue	Bluegrass
					(in.)	
A 0	0	0	16.7 ± 6.0	3.4 ± 1.0	37.3 ± 4.5	20.7 ± 2.5
1/2 lb/A	0	0	5.6 ± 0.6	3.6 ± 1.9	24.4 ± 3.3	17.4 ± 2.5
1/2 lb/A	0.5%	0	4.6 ± 0.8	1.3 ± 1.3	18.3 ± 1.5	13.5 ± 0.7
1/2 lb/A	0	2 lb/A	9.0 ± 4.8	3.3 ± 1.5	25.4 ± 5.8	16.9 ± 1.4
1/2 lb/A	0.5%	2 lb/A	5.3 ± 1.1	2.3 ± 1.0	20.5 ± 5.1	14.3 ± 1.5
B 0	0	0	15.4 ± 2.4	1.4 ± 0.7	33.3 ± 2.7	15.4 ± 2.7
1/2 lb/A	0.5%	1/2 lb/A	8.9 ± 0.5	1.7 ± 2.9	13.8 ± 3.2	9.7 ± 0.3
1/2 lb/A	0.5%	1 lb/A	6.2 ± 4.7	0.7 ± 0.3	11.9 ± 1.9	9.0
1/2 lb/A	0.5%	2 lb/A	6.7 ± 2.4	1.1 ± 1.00	13.4 ± 2.2	12.0 ± 1.0

* As percent of the total spray mixture.

tions between mefluidide and surfactant and between mefluidide, surfactant and 2,4-D amine will be retained in the final mixture, the amount of mefluidide required to control fescue seedheads could be reduced from 1/2 lb/A to possibly 1/8 lb/A (mefluidide effectiveness is about doubled both by mixing with chlorsulfuron and doubled again by application with surfactant). Both in 1983 and 1984, the combinations of 1/4 lb/A mefluidide + 1/4 oz/A chlorsulfuron + 0.25 or 0.5% surfactant + 2 lb/A 2,4-D amine (Schedule B) as well as 1/8 lb/A mefluidide + 1/8 oz/A chlorsulfuron + 0.25% or 0.5% surfactant + 2 lb/A 2,4-D (Schedule C) were equivalent or superior to 1/2 lb/A mefluidide + 0.25 or 0.5% surfactant + 2 lb/A 2,4-D amine (Schedule A). The response to these treatments resulted in the same general trend at all dates of application between the last week of March and the first week of May (Table 6).

Environmental Safety.

Turf remained healthy and vigorous in a series of test plots receiving mefluidide applications (1/2 lb/A) annually for 7 years since the spring of 1977. Neither mefluidide alone nor the combination of mefluidide plus chlorsulfuron resulted in any permanent inhibition of root growth (Table 7), with fescue, or bluegrass. Repeat applications of high rates of mefluidide (e.g. 1 to 2 lb/A) reduce or eliminate some strains of native bluegrass but fescue continues to grow vigorously even in these plots.

Any of the treatments may display some initial phytotoxicity (yellowing) of the grass in the second week post treatment. The discoloration is temporary and is usually gone when the vegetative growth of the grass resumes about 3 weeks after application (Fig. 5).

No problems have been encountered from injury to nontarget species either due to drift or inadvertent direct overspraying under normal roadside use conditions.

Table 6. Summary of comparisons of Schedule A, Schedule B and Schedule C on seedhead formation in fescue and bluegrass comparing all 1984 dates of application under roadside conditions.

	Control of Seedheads, %					
	Fescue			Bluegrass		
Date of application	Sched A 1/2Mef	Sched B 1/4Mef+1/4Chl	Sched C 1/8Mef+1/8Chl	Sched A 1/2Mef	Sched B 1/4Mef+1/4Chl	Sched C 1/8Mef+1/8Chl
April 7	98	99	92	95	50	75
April 10	74	68	68	74	53	53
April 18	90	85	85	84	20	52
April 25	89	93	95	98	79	64
April 26	93	90	-	88	29	-
May 2	52	74	91	(0)	(0)	(0)
May 7	75	85	-	90	51	-
May 8	-	92	100	-	0	38
May 9	71	100	-	75	63	-
May 10	-	100	-	-	38	-
May 14	-	100 95	-	-	30 26	-
May 15	-	100	-	-	25	-
May 17	-	79	-	-	0	-
May 16	67	97	100	(0)	(0)	(0)
Average	79±15	88±11	90±11	86±9	44±20	56±14

Mef = mefluidide; Chl = chlorsulfuron; Rates are lb/A for mefluidide and oz/A for chlorsulfuron. All treatments contained 2 lb/A 2,4-D amine (acid equivalent) and 0.5% X-77 surfactant as % of the total spray mixture applied at 40 gpa and 40 psi.

Table 7. Comparison of Schedule A, Schedule B, and Schedule C on root lengths of fescue and bluegrass. Applications were on April 7, 1984 under roadside conditions. Fescue was 5 inches tall. Bluegrass was 2.5 inches tall. 40 gpa. 40 psi. Evaluations were on June 11, 1984.

	Treatment and amount*				Root length	
Schedule	Mefluidide	X-77	Chlorsulfuron	2,4-D amine	Fescue	Bluegrass
					(cm)	
	-	-	-	-	5.8±0.4	5.6±0.6
A	1/2 lb/A	0.5%	-	2 lb/A	5.9±0.4	6.3±1.4
B	1/4 lb/A	0.5%	1/4 oz/A	2 lb/A	6.5±0.8	5.9±0.7
C	1/8 lb/A	0.5%	1/8 oz/A	2 lb/A	5.0±0.9	5.7±0.4

* Amounts of materials are in rates per acre of active materials except for X-77 which is percent of the total spray mixture. Differences in root length were not statistically significant for any of the treatments.

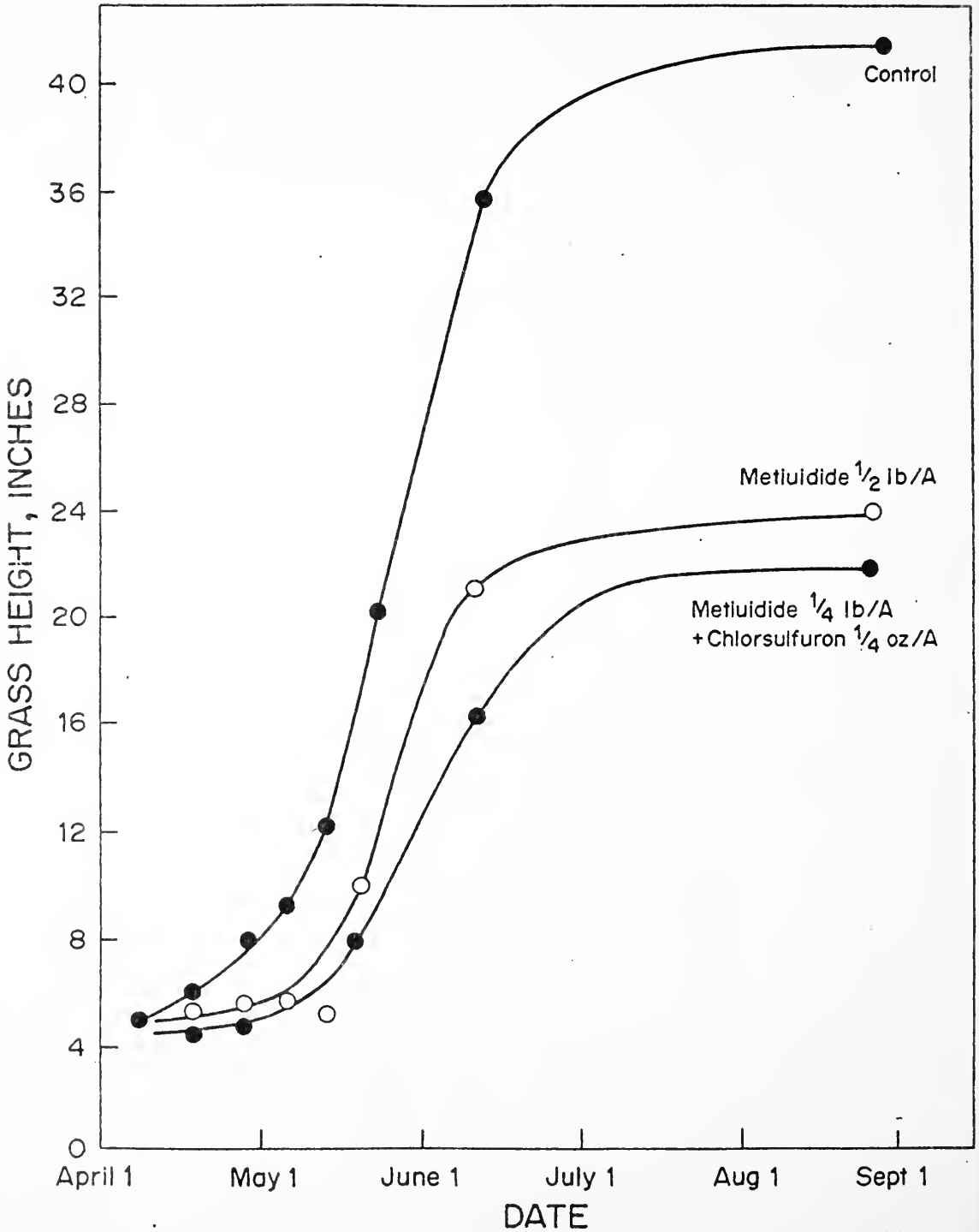

Fig. 5. Growth suppression of fescue by the combination of 1/4 lb/A mefluidide + 1/4 oz/A chlorsulfuron (Telar) + 2 lb/A 2,4-D amine with X-77 surfactant as 0.5% of the total spray mixture (●) compared to the same conditions of 2,4-D and surfactant but with 1/2 lb/A of mefluidide instead (0). Applications were on April 7 under roadside conditions with evaluations on the dates indicated. Values are total grass height.

Implementation Tests, 1982-1984.

In 1984, 1/2 lb/A mefluidide + 0.5% surfactant + 2 lb/A 2,4-D amine were tested successfully using commercial applicators and application equipment with seedhead suppression in fescue averaging about 80% (Table 8). In 1984, a spring application of 1/4 lb/A mefluidide + 1/4 oz/A chlorsulfuron + 2 lb/A 2,4-D amine and 0.25% surfactant was tested and gave 90% control of seedheads of both fescue and bluegrass and of broadleaf weeds (Table 9). The area would not have required mowing at any time during the growing season. Its appearance was equivalent to adjacent road segments that had received a full 3 cycles of mechanical mowing.

Similar trials on secondary roads in Miami County in 1983 were less successful. The treatments were effective in controlling seedheads in fescue and bluegrass as on the dual lane roads. However, the treatments were much less effective on smooth brome, orchard grass and timothy that frequently are present along secondary roads in small clumps. Mowing was reduced from three cycles to one on these roads. The need for mowing was due primarily to growth of late germinating weeds (such as velvetleaf) and annual grasses (e.g foxtail) that tended to dominate these narrow rights-of-way adjacent to cropped fields late in the growing season. While adding to the expense of the mixture, these problems have been overcome by addition of an appropriate preemergence material to the spray mixture.

Discussion

This study demonstrates the practical use of combinations of chemicals to reduce or prevent growth of grass and weeds along roadsides so that the need for mechanical mowing is eliminated or reduced. Mefluidide is the primary retardant in the mixture. Its advantages are effectiveness, safety, and no appreciable inhibition of root growth. By mixing the mefluidide with various

Table 8. Tests under roadside use conditions of mefluidide (1/2 lb/A) + surfactant (0.5%) + 2,4-D amine (2 lb/A)

Year	Location	Fescue seed head suppression	
		Range	Average
1982	Tippecanoe Co.	68-93%	83%
1983	Miami Co.	64-94%	81%

Table 9. Evaluation of a spring application of 1/4 lb/A mefluidide + 1/4 oz/A chlorsulfuron + 2 lb/A, 2,4-D Amine + 0.25% (by volume of total spray mixture) (25 gpa/Swinglok), applied by the Indiana Department of Highways, under actual highway use conditions.Application was on April 18, 1984. Evaluations were on August 24, 1984, 4 months after application.

	Fescue[a]			Bluegrass[a]			
	Seedheads			Seedheads			Weeds/
	per ft^2	height	Blade height	per ft^2	height	Blade height	1000 ft^2
Median:							
Unsprayed	17 ± 1	39 ± 2	15 ± 4	12 ± 4	21 ± 1	13 ± 2	391
Sprayed	2 ± 3	20 ± 5	14 ± 3	2 ± 1	13 ± 3	10 ± 2	30
Control	90%			83%			92%
Pavement to Ditch:							
Unsprayed	15 ± 3	37 ± 2	18 ± 3	7 ± 2	21 ± 1	14 ± 2	468
Sprayed	1.6±1.1	24 ± 2	14 ± 2	9.7±0.6	14 ± 2	11 ± 1	62
Control	90%			90%			87%

[a] Based on measurements from 4 different locations selected at random. Heights are average maximum heights from 10-20 plants per location ± standard deviation among different locations. Rates are of active ingredient. Initial height of bluegrass was 3.5-4 inches. Initial height of fescue was 6-7 inches.

additives, seedheads in fescue are reduced or eliminated at rates that are economically competitive with mechanical mowing.

Additives are employed as a means to decrease the rate of mefluidide required for suppression of seedheads in fescue through a synergistic interaction. One of the most effective additives is chlorsulfuron. The standard treatment of 1/2 lb/A mefluidide + surfactant + 2 lb/A 2,4-D amine (Schedule A, Table 4) can be duplicated or exceeded by 1/4 lb/A mefluidide + Surfactant + 1/4 oz/A chlorsulfuron + 2 lb/A 2,4-D amine. Since neither mefluidide nor chlorsulfuron give satisfactory control of broadleaf weeds, 2,4-D amine is added. 2,4-D amine formulations sometimes show an antagonism with low application rates of mefluidide. However, the antagonism is overcome largely by the surfactant in the mixture. Similar antagonisms have been observed with other broadleaf herbicides including picloram, banvel and silvex.

The effect of the surfactant in increasing effectiveness of both the mefluidide and of the 2,4-D amine is presumably due to enhanced foliar penetration (Blomberg and Wax, 1978). It is becoming increasingly apparent, however, that these materials can also enter the plant via the root system and that the entry route through the soil may be less influenced by the presence or absence of surfactants

Large scale tests of 1/2 lb/A of mefluidide plus surfactant and 2,4-D amine ((Schedule A, Table 6) were applied in 1982 and 1983. Both years, Schedule A was effective in controlling seedheads in fescue and was effective in vegetation management on improved dual lane and interstate highways.

Schedule B, with the addition of chlorsulfuron as an additive, is even more effective. Nearly complete control of fescue seedheads is obtained. Schedule B is also very effective in the control of broadleaf weeds. It is comparable to Schedule A for most species (better than 90% control) and Schedule B is more effective than Schedule A for control of wild carrot.

The most cost effective mixture is Schedule C. This has been examined in detail in small plot studies in 1983 and 1984 and is scheduled for evaluation in large scale tests in 1985.

With any of the schedules, spring applications only are recommended. The materials can be applied in the fall for seedhead control the following spring but much higher rates are required and the fall applications do not appear economical. For Schedules A and B, the materials are applied from green-up until the seedheads just emerge from the boot. With Schedule A, the seedheads will sometimes elongate beyond the point where they are at the time of application. This, however, does not seem to happen with Schedules B and C. With Schedules B and C, the seedheads and grass remain nearly at the stage they are at the time the application is made.

The relative costs of the three schedules has been calculated based on current prices of materials and mowing and application estimates. Both schedules A and B are competitive with one-cycle mowing ($20 + per acre) while Schedule C is considerably less expensive to apply than it is to mow once.

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APPENDICES

Appendix I 1983

SUMMARY OF MAJOR FINDINGS

Appendix II 1984

SUMMARY OF MAJOR FINDINGS

APPENDIX I

1983

SUMMARY OF MAJOR FINDINGS

1983

SUMMARY OF MAJOR FINDINGS

Additional brief discussions of findings and summations are provided with the tables and figures.

1. With a fall application, approximately 50% suppression of fescue seed heads was obtained the following spring at a rate of 1 lb/A of mefluidide. Equivalent to 1/2 lb/A mefluidide or 1/4 lb/A mefluidide plus surfactant applied in the spring. Does not seem like an efficient way to apply such an expensive material (Tables 1 and 2).

2. Tordon (or 2,4-D) applied in combination with Embark in the fall (2 lb/A 2,4-D or 1/2 lb/A Tordon) gave 90-100% control of all weeds and nearly complete control of WILD CARROT (Table 3).

3. Turf remains healthy and vigorous in a series of test plots receiving Embark applications annually since the spring of 1977 (Table 4).

4. A comparison of three surfactants (XM-12, X-77 and WK) did not reveal substantial or consistent differences. All were equally effective and final choice might just as well be based on cost at this point in the evaluation (Tables 5, 9, 10, 12, 13, 18, 19, 21, 29, 30, 34).

5. A mid-March application of Embark + Glean + Surfactant + 2,4-D may have been too early for maximum effectiveness (Table 5).

6. The standard treatment based on 1982 results of 1/2 lb/A Embark as mefluidide + 0.5% surfactant + 2 lb/A 2,4-D amine gave a most satisfactory performance on dual-lane roads in the Miami County test applied April 4, 1983 (81% suppression of seedheads) but failed on the secondary roads due to late growth of weeds (mostly annuals such as velvetleaf or giant foxtail but also due to carrot skips)(Tables 7 and 8)

7. Lower rates of Embark are required on interchanges than adjacent to the fence or adjacent to the pavement for seedhead and height suppression in fesucue (Table 11). Approximately 1/2 as much is required. The same may hold for Embark + Glean combinations.

8. Nothing tested adequately suppressed seedhead formation in smooth brome (Tables 7, 13, 14, 15, 20, 48).

9. DuPont DPX-T6376-2960 (DPX) was approximately twice as effective (oz/oz) as Glean (Tables 16, 17, 21, 22, compare Figs. 3 and 4, etc) but was ineffective on seedhead suppression if applied at an early date of April 28 (Table 14, Fig. 1) Weed control from DPX was about 75-80% overall (Tables 14, 17, 22, 33, 45, 47).

10. Severe phytotoxicity to fescue was noted with rates of Glean of 1/2 oz/A or greater (Tables 15, 25, 31 and Fig. 3). Also DPX (Fig. 4, Tables 27, 47).

11. Weed control by Glean was enhanced by 2,4-D. 1 lb/A was insufficient (Tables 17, 19, 21, 22, 42, 44) and 2,4-D will be retained in the mixtures for 1984 at 2 lb/A (Tables 16, 21, 22, 32, 34, 37, 38, 39, 42, 46).
Embark-2,4-D antagonism seems to be less at the higher 2,4-D rate (Tables 21 was reported from the 1982 test results.

GLEAN - EMBARK COMBINATIONS

12. A positive and potentially cost-saving interaction between Glean and Embark was observed in all tests where comparisons were made. The interaction appears to be a true synergism although the necessary controls to evaluate the degree of syntergism experimentally were not always included and was not the purpose of the study. As a first approximation, the standard treatment of 1/2 lb/A Embark as mefluidide + Surfactant + 2 lb/A 2,4-D amine can be duplicated or exceeded by 1/4 lb/A of Embark as mefluidide + Surfactant + Glean at some rate + 2 lb/A 2,4-D Amine (Tables 20,21,23,27,28,31,34 and 35; See also Table 36).

13. It was not possible to determine the optimum rates of either Embark or Glean in an Embark + Glean mixture from the results obtained, primarily because the effective rates were much lower than expected, the dose dependency for Glean is very steep (a need for tests in 1/16 oz/A increments of Glean are indicated and a large variation is to be expected at intermediate rates)(Fig.3) as compared to Embark (Fig. 2). However, the following arguments can be made relative to setting a recommendation for 1984:

14. To serve as the primary herbicide, rates of Glean of 1/2 oz/A or higher are required (e.g. Tables 45 and 49). These rates are phytotoxic (Fig. 3, Tables 15, 25, 31 and 48) to fescue. Whereas, DPX may be somewhat active against buckhorn plantain (but not common plantain) in the presence of surfactant (but not in its absence) (Tables 45 and 47), Glean is not (Table 49). 2,4-D is (Table 46).

15. Based on phytotoxicity the maximum rate of Glean can be set at 1/4 oz/A. This rate is ineffective to give weed control alone. Therefore, it is necessary to add 2,4-D. Based on effacacy data, low cost and lessened 2,4-D-Embark antagonism, 2 lb/A is suggested (See entry No. 11).

16. Addition of surfactant to Embark enhanced its effectiveness (Fig. 2) but not with Glean (Fig. 3) or DPX except at phytotoxic rates (Fig. 4 and Table 47). A positive 2,4-D + Surfactant interaction in weed control and a lessening by surfactant of 2,4-D - Embark anagonisms was reported in 1982. No adverse effects of adding surfactant to Glean-Embark combinations was noted. The three surfactants tested were equivalent (See entry No. 4). X-77 may be somewhat less phytotoxic than WK and, if anything, XM-12 is the least effective. There is no advantage (perhaps a decrease in effectiveness) in increasing the surfactant above 0.5% (1982 test results). It may be possible to decrease the surfactant to 0.25% without loss of effectiveness (Tab. but the only advantage would be a small reduction in cost. Therefore, we will leave the Surfactant at 0.5% in the total spray mixture using X-77 (or WK depending on preference and cost) and leave the question of lowest effective amount to future cost-reduction studies.

17. This gives us a basic combination of 1/4 lb/A Embark (as mefluidide) + 0.5% X-77 (or WK) + 1/4 oz Glean + 2 lb/A 2,4-D which, in 1983, proved very effective (Tables 5, 20, 21, 23, 27, 28, 31, 34, and 35; see also Table 36) in suppressing fescue seed heads and vegetative growth of fescue. Seed head suppression ranged from 82% (equivalent to 1/2 lb/A Embark + Surfactant + 2,4-D) from a March 18 application (Table 5) to 100% later in the season (May 2) (Table 20. 21, 23. 27, 28, 31, 34, and 35). The latest applications to control seedheads were the first week of May.

SETTING THE RATE OF EMBARK

18. If 1/4 lb/A Embark (as mefluidide) + 0.5% X-77 (or WK) + 1/4 oz Glean + 2 lb/A 2,4-D gives 100% control of fescue seedheads applied midseason to late, can the amount of Embark be reduced further? The answer is yes for late applications but we have insufficient information for early applications.

19. In the Webel test applied on April 21 (Table 11), 1/8 lb/A Embark gave 87% control of seed heads with 1/2 oz/A Glean and 92% control of fescue seed heads with 1/6 oz/A Glean. This test, however was on an interchange. In an IN-126 test applied on April 27, 1/8 lb/A Embark plus 3/8 oz Glean (no 2,4-D) gave 92% control of seedheads and 77% control of fescue seedheads with 1/8 oz Glean plus 1/2 lb 2,4-D (not enough 2,4-D--some antagonism, perhaps Table 13). A May 2 application of 1/8 lb/A Embark + 1/8 oz/A Glean comparing 0, 1 and 2 lb/A 2,4-D gave 93% control of seedheads in fescue or better (Table 18). Similar results were obtained for a May 8 application (Table 29). By May 9, 1/8 lb/A Embark plus 1/4 oz/A Glean (or higher) gave 100% control of fescue seed heads (Table 31). Tests on May 12 and 13 were marred by rains (Table 35) and the final tests on May 17 indicated complete suppression of fescue seed heads by 1/8 lb/A of Embark as mefluidide either with 1/8 or 1/4 oz/A of Glean in the presence or absence of 1 lb/A 2,4-D (not enough) (Table 41). Therefore, we conclude that 1/8 lb/A of Embark (as mefluidide) in combination with some rate of Glean between 1/8 and 1/2 oz/A plus surfactant and 2 lb/A 2,4-D may be sufficient for seedhead suppression in fescue along roadsides especially at the later dates of application.

20. One lower rate of Embark was tested, 1/16 lb/A as mefluidide. The first test was on April 28 in combination with 3/16 oz/A of Glean, 0.25% Surfactant and no 2,4-D. Seedhead suppression was 60% (Table 15). An application on April 30 of 1/16 lb/A Embark + 1/6 oz/A Glean in combination with 0.5% surfactant and 1 lb/A 2,4-D gave 45% control of fescue seedheads (Table 17). A more complete test on May 12 and 13 was rained out (Table 35) but Embark at 1/16 lb/A plus either 1/8, 1/4 or 1/2 oz/A Glean was ineffective. The final test on May 16 indicated about 60% suppression of seedheads with 1/16 lb/A Embark with either 1/8, 3/16 or 1/4 oz/A Glean plus surfactant and 1 lb/A 2,4-D (Table 40). Therefore, we conclude that at practical rates of application of Glean (up to 1/4 oz/A), 1/16 lb/A of Embark as mefluidide is insufficient for roadside purpose.

SETTING THE RATE OF GLEAN

21. Setting the rate of Glean is more difficult since this was the last variable to be tested (the most recent introduction into the combination) and for the reasons noted under Item 13. The following ground rules are suggested.
    a) Rates of Glean greater than 1/4 oz/A not be considered due to phytotoxicit even though effective in weed control or seedhead suppression.

    b) That the final rate of Embark in the mixture will be between 1/16 and 1/2 lb/A probably not more than 1/4 lb/A and probably not less than 1/8 lb/A in combination with surfactant and 2 lb/A 2,4-D.

SETTING THE RATE OF GLEAN (Contd)

22. For 1/4 lb/A of Embark, the following rates of Glean of 1/4 oz/A or less were tested:

Date of Application	Glean, oz/A (active)	% Control of Fescue Seedheads	
March 18	1/4	82%	(Table 5)
May 2	1/4	100%	(Table 20)
May 2	1/4	100%	(Table 21)
May 3	1/4	94%	(Table 23)
May 5	1/4	99%	(Table 27)
May 5	1/4	100%	(Table 28)
May 9	1/4	100%	(Table 31)
May 11	1/4	100%	(Table 34)
May 12 and 13 (rain)	1/8, 1/4 and 1/2 oz were equivalent but 1/8 oz was insufficient to control wild carrot (Table 37)		

23. For 1/8 lb/A of Embark, the following rates of Glean of 1/4 oz/A or less were tested:

Date of Application	Glean, oz/A active	% Control of Fescue Seedheads	
April 27	1/8	77%	(Table 13)
April 30	1/8	99%	(Table 16)
	1/4	98%	
April 30	1/12	27%	(Table 17)
	1/6	60%	
May 2	1/8	93%	(Table 18)
May 8	1/8	98%	(Table 29)
May 12 and 13 (rain)	1/8, 1/4 and 1/2 oz were equivalent		
May 17	1/8	96%	(Table 41)
	1/4	100%	

While lower rates were not tested extensively, it appears that 1/8 oz/A of Glean may be sufficient for seedhead suppression in fescue at least with application dates in May. It may be insufficient if applied early.

24. The final recommended mixtures for 1984 are summarized in Table 50.

Note: Emphasis has been on fescue in formulating treatments. The above rates of Embark + Glean at the rates that control seedhead formation in fescue may not do so with bluegrass especially at the late dates of application. However, the seedheads that form are generally not taller than the vegetative parts of the fescue, are uniform in appearance and do not persist.

Table 1. Effect of Embark alone and in combination with 2,4-D or Tordon on seed head suppression of fescue and bluegrass under roadside conditions. Lindberg Road, West Lafayette, Indiana. Applied October 17, 1982. Evaluations on May 31, 1983. Averages from 3 replications ± standard deviations. 3' X 18' plots adjacent to fence.

		Grass Ht (In)		Seed Heads/Ft^2	
Treatment	Lbs/A	Fescue	Bluegrass	Fescue	Bluegrass
None	-	26 ± 4	22 ± 3	11 ± 3	8 ± 3
Embark	1/2	25 ± 3	21 ± 6	11 ± 1	4 ± 1
	1	25 ± 3	18 ± 2	6 ± 3	3 ± 2
Embark + 2,4-D	1/2 + 2	26 ± 4	17 ± 3	12 ± 2	4 ± 4
	1 + 2	22 ± 2	17 ± 2	9 ± 5	4 ± 2
Embark + Tordon	1/2 + 1/2	26 ± 3	17 ± 5	9 ± 4	6 ± 5
	1 + 1/2	26 ± 1	19 ± 2	9 ± 4	4 ± 2

Some slowing of seed head formation was obtained but generally unsatisfactory. Approximately 50% control of seed heads at 1 lb/A of Embark as mefluidide.

Table 2. Effect of Embark alone and in combination with 2,4-D or Tordon on seed head suppression of fesuce and bluegrass under roadside conditions. Lindberg Road, West Lafayette, IN. Applied October 20, 1982. Evaluations on May 31, 1983. Averages from 3 replications ± standard deviations. 3' X 18' plots adjacent to fence.

		Grass Ht (In)		Seed Heads/Ft^2	
Treatment	Lbs/A	Fescue	Bluegrass	Fescue	Bluegrass
None	-	26 ± 4	21 ± 2	11 ± 1	6 ± 3
Embark	1/2	26 ± 3	23 ± 3	11 ± 1	5 ± 2
	1	26 ± 1	19 ± 5	3 ± 1	3 ± 2
Embark + 2,4-D	1/2 + 2	25 ± 1	21 ± 4	7 ± 4	3 ± 2
	1 + 2	25 ± 1	21 ± 1	4 ± 4	2 ± 1
Embark + Tordon	1/2 + 1/2	23 ± 2	22 ± 0	7 ± 3	7 ± 1
	1 + 1/2	24 ± 1	20 ± 4	5 ± 1	3 ± 2

Summary of all rates of 2,4-D or Tordon combining data from Table 1 with that of Table 2 (above). Percent inhibition is given in parentheses.

None	-	26 ± 0	21 ± 1	11 ± 0	7 ± 1
Embark	1/2	25 ± 1 (4%)	20 ± 3 (5%)	9 ± 2 (18%)	5 ± 2 (29%)
Embark	1	25 ± 2 (4%)	19 ± 2 (10%)	6 ± 2 (45%)	3 ± 1 (57%)

Seed head suppression at 1/2 lb/A was slight; at 1 lb/A about 50%. No clear evidence of Embark-2,4-D antagonism or of Embark-Tordon antagonism in the fall application.

Table 3. Effect of a fall application of 2,4-D amine or Tordon in combination with two rates of Embark on control of broadleaf weeds. Applied October 20, 1982. Evaluations on May 31, 1983. Roadside conditions. Lindberg Road. Adjacent to edge of pavement. Data are total weeds from three replications. 3' X 18' plots.

		Total Weeds						
Treatment	Lbs/A	Dandelion	Plantain	Parsnip	Red Clover	Wild Carrot	All Species	% Control
None	-	9	55	1	4	28	97	0
Embark + 2,4-D	1/2 + 2	4	2	2			8	92
	1 + 2	2	1				3	97
Embark + Tordon	1/2 + 1/2	1		1			2	98
	1 + 1/2	1					1	99

Table 4. Evaluation of continuous Embark plots. Embark (1/2 lb/A, alone or in combination with 2,4-D or K-104 additive has been applied annually in the spring since 1977. Evaluations in 1983 were on April 25, 1983, just prior to the 1983 application of material for 7th successive year. The turf, consisting of both bluegrass and fescue has remained healthy and vigorous. IN-126 Test Area.

	Grass Height (In)	
Treatment	Bluegrass	Fescue
None	3.7 ± 0.6	6.0 ± 1.0
Continuous Embark	2.3 ± 0.3	4.3 ± 0.6

Table 5. Comparison of XM-12 and X-77 Surfactants in combination with Embark, Glean and 2,4-D Amine. IN-126 test area. Applications were on March 18, 1983. Evaluations were on June 20, 1983. Triplicate 3' X 6' plots. Values are averages of the three replicates ± standard deviations. Rain fell 12 h after spraying. Initial heights; fescue 5.4 ± 1 inches, bluegrass 4 ± 0.5 inches.

Amount					Fescue			Bluegrass		
					Seed Head		Blade	Seed Head		Blade
Embark	XM-12	X-77	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	-	12.0 ± 5	47 ± 1	19 ± 1	1.2±0.7	22 ± 1	12 ± 2
1/2 lb	0.5%	-	-	2 lb	2.9 ± 1.2	31 ± 4	16 ± 1	0.9±0.2	17 ± 1	9 ± 2
1/2 lb	-	0.5%	-	2 lb	2.0 ± 0.9	33 ± 4	15 ± 2	0.1±0.1	16 ± 1	9 ± 1
1/4 lb	0.5%	-	3/4 oz	-	0.9 ± 0.9	27 ± 3	15 ± 1	2.0±0.5	13 ± 1	9 ± 1
1/4 lb	-	0.5%	3/4 oz	-	0.7 ± 0.7	28 ± 2	13 ± 1	2.3±1.5	13 ± 1	9 ± 1
1/4 lb	0.5%	-	1/4 oz	2 lb	2.2 ± 0.1	29 ± 5	14 ± 1	1.0±0.9	16 ± 1	9 ± 0
1/4 lb	-	0.5%	1/4 oz	2 lb	4.7 ± 3.0	30 ± 5	13 ± 1	0.5±0.5	14 ± 0	8 ± 0
XM-12 surfactant (all treat.)					2.0 ± 1.0	29 ± 2	15 ± 1	1.3±0.6	15 ± 2	9 ± 0
X-77 surfactant (all treat.)					2.5 ± 2.0	30 ± 2	14 ± 1	1.0±1.2	14 ± 1	9 ± 1

No real difference was observed between the two detergents either in the final data or in intermediate observations made on April 28 or May 21, 1983 (data not shown). The application was too early for maximum effectiveness of the Glean but, even so, 1/4 lb/A of Embark + 1/4 oz/A of Glean + 2 lb/A of 2,4-D was equivalent to 1/2 lb/A of Embark + 2 lb/A of 2,4-D.

Table 6. Comparison of XM-12 and X-77 Surfactants in combination with Embark, Glean and 2,4-D Amine. IN-126 test area. Applications were on March 18, 1983. Evaluations were on June 20, 1983. Triplicate 3' X 6' plots. Values are averages of the three replicates ± standard deviations. Rain fell 12 h after spraying.

Amount					Weeds per 18 ft^2						
Embark	XM-12	X-77	Glean	2,4-D	Red Clover	Plantain	Dandelion	White Clover	Wild Carrot	Other*	Total
-	-	-	-	-	6 ±4	8 ± 7	3 ±1	1 ±2		14 ±22	32 ± 28
1/2 lb	0.5%	-	-	2 lb	0.3±0.3	1.3± 1.2	1 ±2	2 ±3		0.3±0.3	5 ± 6
1/2 lb	-	0.5%	-	2 lb	0.3±0.3	2.3± 1.5	0.7±0.7	0.7±0.7		0.7±0.7	5 ± 4
1/4 lb	0.5%	-	3/4 oz	-		7.3± 6.1	1 ±1			19 ±20	27 ± 27
1/4 lb	-	0.5%	3/4 oz	-		8 ± 2	1 ±1			10 ±20	19 ± 17
1/4 lb	0.5%	-	1/4 oz	2 lb		3 ± 3	2 ±1		0.3±0.3		5 ± 4
1/4 lb	-	0.5%	1/4 oz	2 lb	0.3±0.3	3 ± 2	1 ±1	0.3±0.3		0.3±0.3	5 ± 2
XM-12 Surfactant (All treat.)					0.1±0.2	3.9 ± 3.0	1.1±1.0	0.7±0.7		6.4±10.8	12 ± 13
X-77 Surfactant (All treat.)					0.1±0.2	4.4 ± 3.1	1 ±1	0.2±0.4		3.7±5.4	10 ± 8

*Mostly goldenrod. 12" tall in Glean plots, 26" tall in control plots

84% control of all weeds with 2 lb/A 2,4-D
28% control of all weeds with 3/4 oz/A Glean

No real difference between the two wetting agents.

Table 7. Miami county test. Sprayed April 4, 1983 with 1/2 lb/A Embark + 1% DuPont Surfactant WK using contractual truck-mounted equipment (See Appendix A, attached). Note that the initial specifications were for XM-12 (Sponto) Surfactant which could not be supplied in sufficient quantity by the manufacturer. Evaluations were on June 16, 1983. Initial heights; fescue 6 (median) to 8 inches (edge of pavement), bluegrass 2 (median) to 3 (edge of pavement) inches.

	Fescue			Bluegrass			Orchardgrass			Smooth Brome		
	Seed Head		Blade	Seed Head		Blade	Seed Head		Blade	Seed Head		Blade
Road Segment	No/ft^2	Ht.	Ht.	No/ft^2	Ht.	Ht.	No/ft^2	Ht.	Ht.	No/ft^2	Ht.	Ht.
Control	14±5	44±5		11±2	26±4		11±2	44±4		14±3	44±11	
SR 218	5±3	27±6		1±1	14±1		6±2	29±9		3±1	30±2	
Control	17±2	40±5		11±7	24±3							
SR 19	1±1	17±4		1±1	12±3		2±2	26±5		9±3	29±6	
Control	17±3	44±7		7±3	19±2							
US 31S	3±1	23±3	14±1	0±1*	10±1	11±2	1±1	16±4	12±3	5±3	18±5	
US 31N	4±1	25±3	14±1	1±1	12±2	11±2						
Control (US 31 Median)	16+4	41+3		3±1	18±5							
US 31 S (Median)	2±1	19±5	14±1	1±1	10± 1	10±1				3±1	18±5	10±1
US 31 N (Median)	3±1	27±4	14±1	1±1**	13±2	10±1						
Control (Ave.)	16±1	42±2		8±4	22±4		11±2	44±4		14±3	44±11	
Treated (Ave.)	3±1	23±4	14±1	1±1	12±2	11±1	3±2	24±7	12±3	5±3	24±7	10±1
Treated/Cont. X 100 = %	81%	45%		88%	45%		72%	45%		64%	45%	

* recorded value = 0.3. ** recorded value = 0.8 ± 1.4.

In 1982, seed head suppression from 1/2 lb/A Embark + 0.5 to 1% surfactant was 68-93% in 6 different trials (average 83%).

In 1983, seed head suppression in the Miami county test ranged from 64-94% (average 81%). The expected result on fescue was obtained.

Appendix A

SUPPLEMENTAL SPECIAL PROVISIONS FOR HERBICIDE CONTRACT M-13627
(APPLICATION OF GROWTH RETARDANT)

The following should generally be used by the Fort Wayne District Construction Department and the contractor, Townsend Tree Co., Inc. to provide guidance in the application of the Embark growth retardant solution.

SPRAY MIXTURE

The rates for the mixture are the following: 2 pints of Embark 2S plant growth regulator + ½ gallon 2, 4-D Amine (3.8 lb acid equivalent per gallon) + 0.4 gal XM-12 (Sponto) anionic surfactant (equivalent to 1% of final solution) + 40 gallons of water. This mixture will be applied to each acre in the test area.

TIME OF APPLICATION

Dates of application will generally be between April 4 to April 29 1983. Exact starting date will be determined by Central Office, Division of Maintenance. They will contact the district construction engineer of date to proceed. This determination will be made by visual inspection of "Green-up" of grass in that area. Grass should be 6-8 inches tall if not mowed the preceding fall or 2-4 inches if mowed.

All application must be complete prior to seedhead development for this treatment to be effective. Any area not treated within the test area before seedhead development shall be eliminated from this test and shall be treated under the regular specifications of M-13627. Late greenup of grass may result in extension of application time into May 1983 but in no case will extend beyond appearance of seedheads.

AREA OF TREATMENT

The area to be treated consists of approximately 319 acres on routes: US31 from the Howard-Miami county line north to its intersection with SR218 east; SR218 from its junction with US31 east to the junction with SR19; SR19 from its junction with SR218 south to its junction with SR18; SR18 from its junction with SR19 west to its junction with US31. On state routes 218, 19 and 18 application will be from fence to fence including corner cuts at public road intersections. On US31 application will include the entire median area plus 18 feet from the edge of pavement or paved shoulder outside both north and southbound lanes.

APPLICATION METHODS

It is essential that the Embark mixture be applied as evenly as possible in order to achieve uniform seedhead suppression. The contractor should make every effort to accomplish this. If a heavy freeze occurs during the application period (night temperatures in the low 20°'s F) wait three days after the freeze before resuming applications. It is important that rain not fall on treated areas within 8 hours of application.

MISCELLANEOUS

Because this application is research oriented, various personnel from Purdue University, 3-M Company and central office and district maintenance will be present during as much of the application time as schedules will permit. Recommendations arising from need for immediate corrective action may be made by authorized personnel to the project supervisor and such recommendations will be sufficient to cause the contractor to stop until a problem is resolved. Persons outside the construction department authorized to make such recommendations will be restricted to Dr. D. James Morre', Purdue University; Mr. Wm. Howell or Mr. D. Webel, 3-M Company; John Burkhardt, Division of Maintenance and Ed Edwards, Fort Wayne District Maintenance.

Table 8. Miami County Test. Sprayed April 4, 1983 with 1/2 lb/A Embark + 1% DuPont Surfactant WK using contractual truck-mounted equipment (See Appendix A, Table 7). Note that the initial specifications were for XM-12 (Sponto) surfactant which could not be supplied in sufficient quantity by the manufacturer. Evaluations sere on August 19, 1983.

	Fescue, Ht. (inches)		Bluegrass, Ht. (inches)	
Road Segment	Seed Heads	Blades	Seed Heads	Blades
Control	48	30	28	24
Treated				
SR 19		15-17		12
US 31		14-17		12

On unmowed and unsprayed portions of US 31 fescue seeds heads were still very much in evidence and overall grass height was about 4 ft.

On unmowed and sprayed portions of US 31 fescue seed heads were no longer evident and the appearance going into the fall was satisfactory. Except for a narrow strip advacent to the pavement, weed control (including carrot) was excellent.

On unmowed and sprayed portions of secondary roads, growth of annual weeds (velvet leaf, giant foxtail, smartweed, pigweed, etc., etc.) made the roadsides rather unsightly. Grass control, however, was equivalent to that on U.S. 31.

An additional problem with the secondary roads encounted early was that, while effective against fescue and bluegrass, the retardant mixture gave only about 50% suppression of seed heads in orchardgrass and smooth brome. Smooth brome seed heads were persistent and still very much in evidence on August 19.

On the secondary roads, control of wild carrot was inadequate due to the extremely heavy starting infestations.

Table 9. Comparison of XM-12, X-77 and WK Surfactants on vegetative growth and seed head formation in bluegrass and tall fescue. Miami county adjacent to US 31. Applied April 12, 1983 using flood tip nozzles (F3) at 20 gpa and 30 psi by Dan Webel, 3M. Evaluations were on June 16, 1983. Results are from three replicates ± standard deviations.

	Amount					Fescue			Bluegrass		
						Seed Head		Blade	Seed Head		Blade
No.	Embark	XM-12	WK	X-77	2,4-D	No./10 ft^2	Ht.	Ht.	No./10 ft^2	Ht.	Ht.
1	1/2 lb	0.5%	-	-	2 lb	9 ± 3	31±7	20±6	5 ± 6	18±1	16±2
2	1/2 lb	-	0.5%	-	2 lb	8 ± 3	27±8	18±2	6 ± 3	20±2	16±2
3	1/2 lb	-	-	0.5%	2 lb	7 ± 3	28±6	18±4	4 ± 5	18±2	17±2
4	1/2 lb	-	-	-	2 lb	8 ± 4	27±9	18±4	8 ± 6	19±4	17±2
5	1/2 lb	0.25%	-	-	2 lb	8 ± 6	24±6	20±2	4 ± 1	19±8	17±1
6	1/2 lb	-	0.25%	-	2 lb	11 ± 5	29±3	21±3	2 ± 1	20±2	18±1
7	1/2 lb	-	-	0.25%	2 lb	9 ± 3	25±6	20±2	3 ± 3	17±2	15±0
8	1/2 lb	-	-	-	2 lb	16 ± 4	33±3	23±2	3 ± 3	16±2	15±1
9	3/8 lb	0.5%	-	-	2 lb	13 ± 3	31±1	21±1	4 ± 3	20±1	18±1
10	3/8 lb	-	0.5%	-	2 lb	9 ± 6	27±7	20±4	6 ± 2	17±1	16±3
11	3/8 lb	-	-	0.5%	2 lb	5 ± 1	28±3	20±1	5 ± 2	20±3	18±0
12	3/8 lb	-	-	-	2 lb	10 ± 9	31±5	22±1	7 ± 4	21±1	19±2
13	3/8 lb	0.25%	-	-	2 lb	10 ± 9	28±3	19±2	4 ± 4	17±1	16±1
14	3/8 lb	-	0.25%	-	2 lb	9 ± 2	31±3	20±3	7 ± 4	20±4	17±3
15	3/8 lb	-	-	0.25%	2 lb	7 ± 6	30±2	19±2	7 ± 7	18±5	17±2
16	3/8 lb	-	-	-	2 lb	8 ± 5	28±3	20±1	11 ± 5	20±2	18±1
17	-	-	-	-	-	22 ± 8	36±4	23±1	7 ± 3	25±3	20±3

These data are further summarized and analyzed in Table 10.

Table 10. Comparison of XM-12, X-77 and WK Surfactants on vegetative growth and seed head formation in bluegrass and tall fescue. Miami County adjacent to US 31. Applied April 12, 1983 using flood tip nozzels (F3) at 20 gpa and 30 psi by Dan Webel, 3M. Evaluations were on June 16, 1983. Results are summarized from Table 9 and represent averages ± standard deviations.

	Fescue			Bluegrass		
	Seed Head		Blade	Seed Head		Blade
Treatment	No./10 ft^2	Ht.	Ht.	No./10 ft^2	Ht.	Ht.
1/2 Emb + 0.5% Det + 2 D	8 ± 1	28±2	19±1	5 ± 1	19±1	16±1
1/2 Emb + 0.25% Det + 2 D	9 ± 2	26±2	20±1	3 ± 1	19±2	17±1
1/2 Emb + 2 D	12 ± 4	30±3	21±2	6 ± 2	18±2	16±1
3/8 Emb + 0.5% Det + 2 D	9 ± 4	29±2	20±1	5 ± 1	19±2	17±1
3/8 Emb + 0.25% Det + 2 D	9 ± 2	30±2	19±1	6 ± 1	18±1	17±1
3/8 Emb + 2 D	9 ± 1	30±2	21±1	9 ± 1	21±1	18±1
1/2 or 3/8 Emb + 0.5% Det + 2 D	9 ± 2	29±2	20±1	5 ± 1	19±1	17±1
1/2 or 3/8 Emb + 0.25% Det + 2 D	9 ± 1	28±3	20±1	5 ± 2	19±1	17±1
1/2 or 3/8 Emb + 2 D	11 ± 4	30±3	21±2	7 ± 3	19±2	17±2
1/2 or 3/8 Emb + 0.5% XM-12 + 2 D	11 ± 2	31±0	21±1	4 ± 1	19±1	17±1
1/2 or 3/8 Emb + 0.5% WK + 2 D	9 ± 1	27±0	19±1	6 ± 0	18±2	16±0
1/2 or 3/8 Emb + 0.5% X-77 + 2 D	6 ± 1* (72%)	28±0	19±1	4 ± 1	19±1	17±1
1/2 or 3/8 Emb + 0.25% XM-12 + 2 D	9 ± 1	26±2	19±1	4 ± 0	18±1	17±1
1/2 or 3/8 Emb + 0.25% WK + 2 D	10 ± 1	30±1	20±1	5 ± 4	20±0	17±1
1/2 or 3/8 Emb + 0.25% X-77 + 2 D	8 ± 1	27±1	19±1	5 ± 2	18±1	16±1
1/2 or 3/8 Emb + 0.5% / 0.25% XM-12 + 2 D	10 ± 2	29±3	20±1	4 ± 1	19±1	17±1
1/2 or 3/8 Emb + 0.5% / 0.25% WK + 2 D	9 ± 2	29±2	20±1	5 ± 2	19±2	17±1
1/2 or 3/8 Emb + 0.5% / 0.25% X-77 + 2 D	7 ± 2* (68%)	28±2	19±1	5 ± 2	18±2	17±1
3/8 Emb + Det (all rates) + 2 D	9 ± 2	29±2	20±1	6 ± 2	19±1	17±1
1/2 Emb + Det (all rates) + 2 D	10 ± 3	28±3	20±2	4 ± 2	18±1	16±1
% of Control	21%	15%	57%	26%	18%	29%

* Differences highly significant.

Table 11. Embark-Glean combinations on vegetative growth and seed head formation in fescue. Treatments applied April 21, 1983 by Dan Webel, 3M. Evaluations were on June 23, 1983. Plots were located on an interchange at I-74 and I-65 south of Indianapolis. Averages are from 3 replicates ± standard deviations. There was insufficient bluegrass to make an evaluation on this species.

	Amount			Fescue		
No.	Embark	X-77	Glean	Seed Heads/10 ft^2	Seedhead Height	Blade Height
1	3/8 lb (1 1/2 pt)/A	0.25%	-	14 ± 5	38 ± 2	24 ± 1
2	1/4 lb (1 pt)/A	0.25%	-	18 ± 7	37 ± 1	21 ± 1
3	1/8 lb (1/2 pt)/A	0.25%	-	32 ± 16	42 ± 4	23 ± 1
4	-	0.25%	1 1/2 oz/A	46 ± 30	33 ± 2	21 ± 1
5	-	0.25%	1/2 oz/A	48 ± 40	35 ± 4	22 ± 4
6	-	0.25%	1/6 oz/A	80 ± 23	44 ± 5	23 ± 3
7	3/8 lb (1 1/2 pt)/A	0.25%	1/2 oz/A	2 ± 1	20 ± 3	16 ± 1
8	1/4 lb (1 pt)/A	0.25%	1/2 oz/A	4 ± 2	25 ± 4	18 ± 2
9	1/8 lb (1/2 pt)/A	0.25%	1/2 oz/A	11 ± 4	31 ± 1	18 ± 2
10	3/8 lb (1 1/2 pt)/A	0.25%	1/6 oz/A	4 ± 1	32 ± 3	19 ± 2
11	1/4 lb (1 pt)/A	0.25%	1/6 oz/A	7 ± 2	34 ± 4	19 ± 2
12	1/8 lb (1/2 pt)/A	0.25%	1/6 oz/A	7 ± 2	33 ± 4	19 ± 2
13	-	-	-	85 ± 26	48 ± 4	23 ± 1
14*	3/16 lb (3/4 pt)/A	0.25%	1/4 oz/A	5 ± 2	23 ± 2	17 ± 3

* Border sprayed at this rate. Photographed.

1/4 lb/A Embark (as mefluidide) + 1/2 oz/A or 1/6 oz/A Glean gave 95% or 92% control of fescue seed heads as did 1/8 lb/A Embark + 1/6 oz/A Glean and 3/16 lb/A Embark + 1/4 oz/A Glean. This test, however, was on an interchange and effective rates may be 1/2 of those required for control of fescue adjacent to the fence or pavement.

Table 12. Comparison of XM-12 and WK Surfactants on growth and seedhead suppression of fescue and bluegrass. IN-126 test area adjacent to pavement. Applications were on April 25, 1983 with evaluation on May 21, 1983. Initial height; fescue = 6 ± 1 inches, bluegrass 3.5 ± 0.5 inches.

Amount				Fescue			Bluegrass		
				Seed heads		Blade	Seed heads		Blade
Embark	XM-12	WK	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	23 ± 3	27 ± 2	14 ± 1	11 ± 1	17 ± 2	13 ± 1
1/2 lb	0.5%	-	2 lb	0.5±0.4	13 ± 2	9 ± 2	0 ± 0	-	4 ± 0.5
1/2 lb	-	0.5%	2 lb	0.3±0.1	8 ± 2	8 ± 2	0 ± 0	-	3.5±0.5

Although not statistically significant, WK was slightly superior to XM-12.

Table 13. XM-12 and X-77 Surfactants in combination with two rates of Embark and Glean. IN-126 test area adjacent to fence. 6' X 15' plots in triplicate. Applied April 27, 1983 with final evaluations on June 16, 1983. Initial heights; fescue 8 ± 1 inches, bluegrass 7 ± 0 inches.

Amount					Seedheads					
					Fescue		Bluegrass		Smooth Brome	
Embark	XM-12	X-77	Glean	2,4-D	Per ft^2	Height	Per ft^2	Height	Per ft^2	Height
-	-	-	-	-	13 ± 1	39 ± 1	6 ± 2	30 ± 3	4 ± 1	35 ± 4
1/4 lb	0.5%	-	-	1 lb	6 ± 3	36 ± 3	2 ± 1	19 ± 4	2 ± 2	31 ± 1
1/4 lb	-	0.5%	-	1 lb	6 ± 3	33 ± 3	2 ± 1	21 ± 2	2 ± 1	31 ± 2
1/8 lb	0.5%	-	3/8 oz	-	1 ± 1	24 ± 9	2 ± 1	20 ± 1	4 ± 0	33 ± 3
1/8 lb	-	0.5%	3/8 oz	-	1 ± 2	22 ± 2	3 ± 1	18 ± 3	4 ± 2	32 ± 4
1/8 lb	0.5%	-	1/8 oz	1/2 lb	3 ± 2	31 ± 4	3 ± 2	20 ± 2	4 ± 0	36 ± 2
1/8 lb	-	0.5%	1/8 oz	1/2 lb	3 ± 1	33 ± 3	2 ± 1	22 ± 2	6 ± 2	37 ± 1

No apparent difference between XM-12 and X-77 surfactants.

1/8 lb Embark (as mefluidide) + either 3/8 or 1/8 oz Glean was superior to 1/4 lb/A Embark alone. Note that 2,4-D was a variable in the test.

Seed heads of smooth brome were not adequately suppressed by any of the treatments.

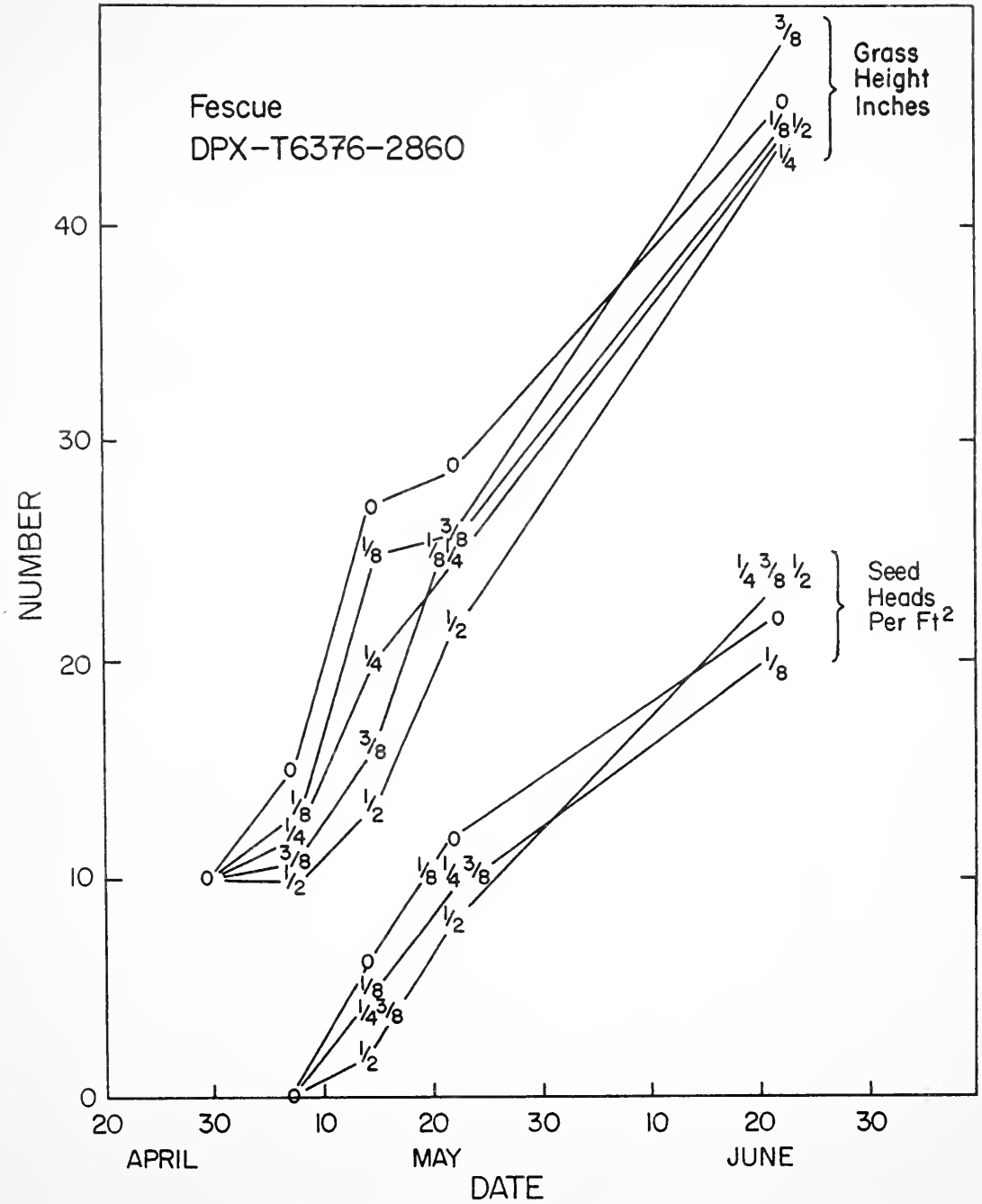
Table 14. DPX-T6376-2960 (DPX) amount on seed head formation and vegetative growth of fescue, bluegrass and smooth brome as well as control of broad-leaf weeds. Applications were on April 28, 1983 with evaluations on June 22, 1983. Plots were 3' X 7.5' in triplicate. IN-126 test area. Initial heights; fescue 10 ± 2 inches, bluegrass 8 ± 2 inches. Results are averages of 3 replicates ± standard deviations.

	Fescue			Bluegrass			Smooth Brome			
DPX	Seed heads		Blade	Seed heads		Blade	Seed heads		Blade	Weeds**
oz/A*	Per ft^2	Height	Height	Per ft^2	Height	Height	Per ft^2	Height	Height	Per 70 ft
0	22 ± 2	46±2	22±2	6 ± 3	23±1	19±1	18 ± 2	44±2		8
1/8	19 ± 3	46±5	20±2	6 ± 3	23±1	19±3	17 ± 2	45±1	18±2	5
1/4	20 ± 2	43±3	24±2	5 ± 2	23±3	18±2	21 ± 2	45±6	20±2	2
3/8	17 ± 5	48±3	24±2	6 ± 2	21±4	18±1	15 ± 3	46±6	20±1	1
1/2	18 ± 3	46±3	24±2	4 ± 1	19±1	18±1	20 ± 2	46±3	18±2	1

* DPX-T6376-2860 (DuPont) 60% active material applied in oz/A of active ingredient.

** Resistant species included plantain, canada thistle and moth mullein. Weed control from DPX was about 75%.

DPX applied early (April 28) was ineffective in suppression of seed heads of fescue, bluegrass or smooth brome at rates to and including 1/2 oz/A. Evaluations on May 7 showed inhibition of vegetative growth ($E.D._{50}$ at 1/4 oz/A; nearly complete inhibition at 1/2 oz/A) of fescue. On May 14, there was an apparent 50% suppression of seed head formation at 1/4 and 3/8 oz/A of DPX for both fescue and bluegrass. This effect was much less apparent in data collected May 21 and was completely gone by June 22. Seed head formation was delayed by about 1 week but not inhibited. These data are illustrated in the accompanying Figure 1.



Appendix Fig. 1. DPX-T6376-2860 amount (oz/A of active material) on growth and seedhead formation in fescue. Applications were on April 28, 1983. Evaluations were on June 22, 1983. See Table 14 for experimental details.

Table 15. Varying rates of Embark, X-77 surfactant and Glean in constant proportions on growth and seedhead formation on fescue, bluegrass and smooth brome. Triplicate 6' X 7.5' plots. IN-126 test area. Applications were on April 28, 1983 with final evaluations on June 22, 1983. Initial heights; fescue 11 ± 1 inches, bluegrass 7 ± 1 inches. Results are averages of three replicates ± standard deviations. Plots located adjacent to fence.

Amount*			Fescue			Bluegrass			Smooth Brome			
			Seed heads			Seed heads			Seed heads			
Embark	X-77	Glean	Per ft^2	Height	Blade Height	Per ft^2	Height	Blade Height	Per ft^2	Height	Blade Height	Weeds** Per 100 ft^2
-	-	-	22 ± 2	43 ± 3	21 ± 1	9 ± 2	25 ± 0	19 ± 1	12 ± 2	40 ± 8	16 ± 0	5
1/16	0.25%	3/16	9 ± 4	24 ± 6	21 ± 0	8 ± 3	25 ± 2	16 ± 2	9 ± 3	40 ± 7	16 ± 1	1
1/8	0.5%	3/8	7 ± 1	22 ± 4	21 ± 1	3 ± 3	20 ± 2	16 ± 2	7 ± 7	33 ± 10	16 ± 1	0
3/16	0.75%	9/16	2 ± 2	21 ± 1	15 ± 3	3 ± 0	20 ± 3	13 ± 1	6 ± 3	34 ± 6	17 ± 1	2
1/4	1%	3/4	1 ± 1	16 ± 3	13 ± 1	3 ± 0	21 ± 1	13 ± 2	4 ± 1	20 ± 11	16 ± 2	3

* Embark = lb/A as mefluidide; Glean = oz/A of active material based on 75% active material; X-77 % by volume.

** Resistant species included plantain, ground cherry and bull nettle. Overall, the Embark + Glean combinations resulted in approximately 70% weed control although the weed population in these plots was very sparse.

The initial ratio of Glean to Embark (2:1) was too high. Extreme phytotoxicity was noted on May 21 down to and including 1/8 lb/A Embark + 3/8 oz/A Glean. Grass was dying at the highest rate of application. Strong phytotoxicity was noted also on May 14 but not to the same extent as on May 21. Orchard grass present in one replicate of 1/8 lb/A Embark + 3/8 oz Glean produced seed heads but short.

A major effect of the treatment was to delay formation of seed heads. On May 21, there were no seed heads in any of the treated plots whereas the untreated control plots showed 11 ± 3 seedheads for fescue and 9 ± 2 seedheads for bluegrass. The seed heads present appeared late for all treatments but further seedheads did not appear.

Table 16. Embark + Surfactant supplemented either with Glean or DPX-T6376-2960 (DPX). IN-126 test area. Triplicate 3' X 3' plots. Application on April 30, 1983. Evaluations on June 20, 1983. Initial heights; fescue 5 ± 1 inches, bluegrass 4 ± 1 inches. Results are averages from the 3 replicates ± standard deviations.

Amount*					Fescue			Bluegrass			
					Seedheads		Blade	Seedheads		Blade	Weeds
Embark	X-77	Glean	DPX	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per 10 ft^2
-	-	-	-	-	8.2±2.3	42±2	14± 3	1.9±0.6	18±1	10±1	35 ± 19
1/8 lb	0.5%	1/4 oz	-	2 lb	0.7±0.8	21±3	11±2	0.3±0.3	11±1	7±1	3 ± 4
1/8 lb	0.5%	1/2 oz	-	2 lb	0.1±0.1	13±2	11±1	0.5±0.2	9±3	7±1	1 ± 1
1/8 lb	0.5%	-	1/8 oz	2 lb	0.1±0.0	10±4	10±1	0.1±0.1	10±0	6±1	1 ± 1
1/8 lb	0.5%	-	1/4 oz	2 lb	0.2±0.3	11±2	10±1	0.0±0.1	10±0	7±1	1 ± 1
1/2 lb	0.5%	-	-	2 lb	0.4±0.6	15±3	11±2	0.1±0.2	10±0	7±1	6 ± 5

With 1/8 lb/A of Embark plus either 1/4 or 1/2 oz of Glean and 1/8 or 1/4 oz of DPX, control of both fescue seed heads and of weeds was 97% and equal to the standard treatment of 1/2 lb Embark. All treatments were with 0.5% X-77 Surfactant and 2 lb/A 2,4-D amine.

* Embark = lb/A as mefluidide

X-77 = % by volume of total spray mix

Glean = oz/A of active material (based on 75% active material)

DPX = DPX-T6376-2960 as oz/A of active material (based on 60% active material)

Table 17. Embark + Surfactant + 2,4-D supplemented either with Glean or DPX-T6376-2960 (DPX). IN-126 test area. Triplicate 3' X 7.5' plots. Applications on April 30, 1983. Evaluations on June 33, 1983. Initial heights: fescue 12 ± 2 inches, bluegrass 8 ± 2 inches. Results are averages from the 3 replicates ± standard deviations.

Amount (see Table 16 footnote)					Fescue			Bluegrass			Smooth Brome			
					Seed Heads		Blade	Seed Heads		Blade	Seed Heads		Blade	Weeds
Embark	X-77	Glean	DPX	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per ft^2	Height	Height	Per 70 ft^2
-	-	-	-	-	22±4	50±2	22±3	16±3	29±2	18±2	16±7	45±1		5
1/8 lb	0.5%	1/12 oz	-	1 lb	16±2	37±1	24±2	6±3	25±1	14±2	12±0	42±4	16±4	2
1/8 lb	0.5%	1/6 oz	-	1 lb	9±5	31±5	22±2	5±3	25±4	13±1	13±2	39±6	17±3	1
1/16 lb	0.5%	1/12 oz	-	1 lb	9±3	36±7	23±1	6±3	24±1	15±1	13±1	44±6	16±1	3
1/16 lb	0.5%	1/6 oz	-	1 lb*	12±6	37±6	24±2	7±5	26±2	15±2	10±3	47±5		1
1/8 lb	0.5%	-	1/24 oz	1 lb**	11±1	38±2	21±6	3±3	20±3	16±1	8±4	50±1		0
1/8 lb	0.5%	-	1/12 oz	1 lb***	11±2	39±5	23±3	3±1	24±4	13±1	13±1	40±1		1
1/16 lb	0.5%	-	1/24 oz	1 lb	20±2	49±5	23±2	4±2	29±1	14±2	11±2	40±2		3
1/16 lb	0.5%	-	1/12 oz	1 lb	18±4	47±1	21±2	4±2	29±1	14±2	10±2	45±5		2

* Orchardgrass 40±3 inches tall, 7±0 seedheads/ft^2

** Orchardgrass 48±1 inches tall, 9±1 seedheads/ft^2

*** Looked very good in the final analysis. Excellent visual appearance, minimal phytotoxicity. Too many fescue seed heads, however.

No fescue seedheads in any of the treatments through May 21 when control plots were 75% headed out. All seedheads in treated plots appeared late. Weed control was about 70% in all treatments. Probably need to stick with 2 lb/A 2,4-D.

Table 18. Comparison of X-77 and WK Surfactants with Embark + Glean + 2,4-D combination. IN-126 test area. Triplicate 3' X 3' plots. Applications on May 2, 1983. Evaluations on June 20, 1983. Initial heights; fescue 5 ± 1 inches, bluegrass 3 ± 0 inches. Grass had been mowed once prior the week prior to spraying. Results are averages from the 3 replicates ± standard deviations.

Amount*					Fescue			Bluegrass		
					Seedhead		Blade	Seedhead		Blade
Embark	X-77	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	-	5.6±2.0	39 ± 3	11 ± 1	0.8±1.0	14 ± 1	7 ± 2
1/8 lb	0.5%	-	1/8 oz	1 lb	0.3±0.3	18 ± 1	9 ± 1	0.7±0.7	11 ± 2	6 ± 1
1/8 lb	-	0.5%	1/8 oz	1 lb	0.1±0.1	15 ± 9	11 ± 3	0.4±0.5	9 ± 1	6 ± 0
1/8 lb	-	-	1/8 oz	1 lb	0.4±0.6	15 ± 2	9 ± 1	0.2±0.2	9 ± 2	6 ± 0

95% control of fescue seed heads. No effect of wetting agent.

Table 19. Comparison of X-77 and WK Surfactants with Embark + Glean + 2,4-D combination. Conditions as in Table 18 (above). Evaluations on June 20, 1983.

Amount*					Weeds/10 ft^2					
							Black	Wild		
Embark	X-77	WK	Glean	2,4-D	Red Clover	Plantain	Medic	Carrot	Other	Total
-	-	-	-	-	7 ± 6	57 ± 22	7 ± 6	0.3±0.3		71 ± 19
1/8 lb	0.5%	-	1/8 oz	1 lb	0.3±0.3	9 ± 7				10 ± 9
1/8 lb	-	0.5%	1/8 oz	1 lb	0.7±1.3	5 ± 6		0.3±.3	0.3±0.3	6 ± 7
1/8 lb	-	-	1/8 oz	1 lb		6 ± 6				6 ± 6

90% control of all weeds. Both X-77 and WK slightly inferior to no wetting agent. 1/8 lb/A Embark + 1/8 oz Glean + 1 lb/A 2,4-D amine not enought for good weed control.

* Embark = lb/A as mefluidide
X-77 and WK = % by volume of total spray mix
Glean = oz/A of active material (based on 75% active)
2,4-D = lb/A of 2,4-D acid as the dimethylamine salt

Table 20. Embark + X-77 + Glean + 2,4-D Combination on growth and seedhead formation in fescue, bluegrass and smooth brome. IN-126 test area. Triplicate 3' X 15' plots. Application on May 2, 1983. Evaluations on June 28, 1983. Initial heights; fescue 12 ± 0 inches, bluegrass 8 ± 1 inches. Results are averages from 3 replicates ± standard deviations.

Amount*				Fescue			Bluegrass			Smooth Brome			
				Seedheads		Blade	Seedheads		Blade	Seedheads		Blade	Weeds
Embark	X-77	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per ft^2	Height	Height	Per 70 ft^2**
-	-	-	-	16 ± 2	44±6	22±2	8 ± 4	26±2	16±2	12 ± 0	44±14		16
1/4 lb	-	-	-	10 ± 2	35±6	22±3	6 ± 2	23±3	15±1	9 ± 1	38±7		14
-	-	1/4 oz	-	12 ± 0	35±3	21±1	9 ± 2	23±4	14±0	10 ± 0	38±7		0
1/4 lb	-	1/4 oz	-	2 ± 1	22±4	21±3	5 ± 3	27±4	17±0	6 ± 3	30±8		1
1/4 lb	0.5%	1/4 oz	- ***	0 ± 1	20±7	20±2	4 ± 1	23±0	17±1	9 ± 2	33±8		0
1/4 lb	0.5%	1/4 oz	2 lb	0 ± 1	20±1	21±1	4 ± 2	24±3	16±2	8 ± 5	43±1		0

* Embark = lb/A as mefluidide; X-77 = % by volume of total spray mixture; Glean = oz/A active material; 2,4-D = lb/A of 2,4-D acid equivalent as the dimethylamine salt.

** Species present in the untreated plots and plots treated with Embark alone and control by the other treatments included dandelion, dock, red clover, milkweed, plantain, goldenrod/aster, white clover and annual thistle.

*** Orchardgrass 21 inches high with 3 seedheads/ft^2. Application on May 2 still too early for control of smooth brome. Bluegrass already starting to form seed heads at the time of application.

Table 21. Varying rates of 2,4-D amine in combination with Embark plus X-77 Surfactant and either Glean or DPX-T6376-2960 on growth and seedhead formation in fescue, bluegrass and smooth brome. Applied May 2, 1983. Evaluations on June 22, 1983. IN-126 test area. 3' X 15' plots. Initial heights; fescue 11.5 ± 0.5 inches, bluegrass 8 ± 1 inches. Results are averages from three replications ± standard deviations.

Amount*					Fescue			Bluegrass			Smooth Brome	
					Seedheads		Blade	Seedheads		Blade	Seedheads	
Embark	X-77	Glean	DPX	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per ft^2	Height
-	-	-	-	-	15 ± 1	48 ± 4	21 ± 1	6 ± 0	31 ± 4	17 ± 2	11 ± 3	46 ± 2
1/4 lb	0.5%	1/4 oz	-	-	4 ± 0	20 ± 1	20 ± 1	1 ± 0	10 ± 2	15 ± 1	11 ± 3	40 ± 3
1/4 lb	0.5%	1/4 oz	-	1 lb	7 ± 1	25 ± 1	18 ± 2	11 ± 1	27 ± 4	15 ± 1	12 ± 3	48 ± 1
1/4 lb	0.5%	1/4 oz	-	2 lb	0 ± 2	20 ± 1	18 ± 1	10 ± 4	28 ± 3	16 ± 1	10 ± 5	50 ± 1
1/4 lb	0.5%	-	1/8 oz	- **	3 ± 1	17 ± 3	18 ± 1	9 ± 5	27 ± 1	16 ± 2	none present	
1/4 lb	0.5%	-	1/8 oz	1 lb***	2 ± 1	21 ± 7	18 ± 2	9 ± 1	26 ± 1	15 ± 2	"	"
1/4 lb	0.5%	-	1/8 oz	2 lb****	2 ± 2	20 ± 2	19 ± 1	10 ± 4	25 ± 2	16 ± 2	"	"

* Embark = lb/A as mefluidide; X-77 = % by volume of total spray mixture; Glean = oz/A active material; DPX = oz/A of active material contained in 60% DPX-T6376-2960; 2,4-D = lb/A of acid equivalent as the dimethylamine salt.

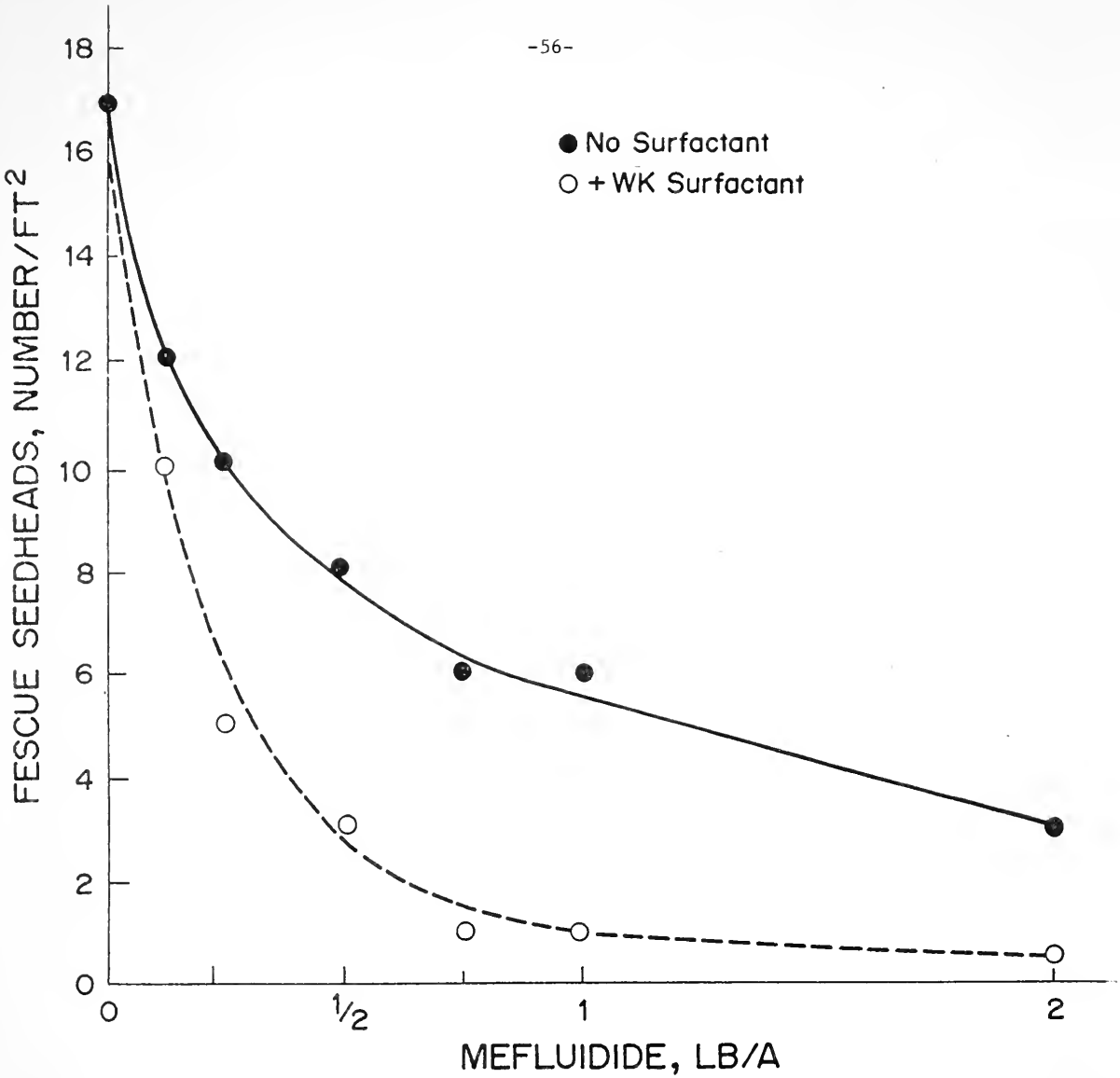
** Good appearance of grass but poor weed control (See Table 22).
*** Looks better (more uniform in appearance)
**** Best looking plot, best weed control (weed control impression not substantiated by counts taken on July 1 (Tab. 22

Some indication of 2,4-D - Embark antagonism in the presence of Glean but not with DPX. 2 lb/A of 2,4-D no worse (maybe less antagonism) that 1 lb/A of 2,4-D in this regard. The antagonism was seen only with bluegrass not with fescue in this experiment.

Table 22. Weed control by varying rates of 2,4-D amine in combination with Embark plus X-77 Surfactant and either Glean or DPX-T6376-2960. Applied May 2, 1983. Conditions as given in Table 21. IN-126 test area. Evaluations were on July 1, 1983.

Amount					Weeds per 180 ft^2						
Embark	X-77	Glean	DPX	2,4-D	Buckhorn Plantain	Dandelion	Wild Carrot	Red Clover	White Clover	Other	Total
-	-	-	-	-	25	8	19	3	23	0	78
1/4 lb	0.5%	1/4 oz	-	-	14	8	7	0	0	1	30
1/4 lb	0.5%	1/4 oz	-	1 lb	1	3	1	1	7	0	13
1/4 lb	0.5%	1/4 oz	-	2 lb	3	0	0	1	0	0	4 (95%)
1/4 lb	0.5%	-	1/8 oz	-	3	1	2	0	0	0	6 *
1/4 lb	0.5%	-	1/8 oz	1 lb	0	1	0	0	0	0	1
1/4 lb	0.5%	-	1/8 oz	2 lb	1	2	3	0	0	0	6

* Appears that 1/8 oz/A of DPX controls buckhorn plantain.



Appendix Fig. 2. Embark amount (lb/A as mefluidide) on seedhead formation in fescue. Applications were on May 3, 1983. Evaluations were on June 22, 1983. IN-126 site. The surfactant was present as 0.5% of the total spray mixture. Plots were 3' X 15' and in triplicate. Initial height of fescue was 11 $\pm$ 1 inches.

Table 23. Embark amount (lb/A as mefluidide) on seedhead formation and seedhead height in fescue and bluegrass. Applications on May 3, 1983. Evaluations on June 22, 1983. TN-126 site. Plots were 3' X 15' in triplicate. Results are averages ± standard deviations. Initial heights; fescue 11 ± 1 inches, bluegrass 7 ± 2 inches.

Amount*				Fescue			Bluegrass		
				Seedhead		Blade	Seedhead		Blade
Embark	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	17 ± 5	46 ± 3	20 ± 5	9 ± 4	29 ± 2	20 ± 1
1/4 lb	0.5%	1/4 oz	2 lb	1 ± 1	22 ± 1	19 ± 3	15 ± 5	25 ± 2	19 ± 2
1/8 lb	-	-	-	12 ± 2	41 ± 11	23 ± 2	15 ± 7	25 ± 2	18 ± 1
1/4 lb	-	-	-	8 ± 2	33 ± 10	22 ± 1	7 ± 4	21 ± 3	16 ± 1
1/2 lb	-	-	-	6 ± 3	28 ± 5	21 ± 2	5 ± 4	19 ± 2	16 ± 1
3/4 lb	-	-	-	6 ± 0	25 ± 3	20 ± 1	6 ± 2	15 ± 1	14 ± 1
1 lb	-	-	-	9 ± 3	34 ± 3	18 ± 2	9 ± 8	17 ± 5	12 ± 1
2 lb	-	-	-	5 ± 1	20 ± 2	19 ± 2	4 ± 1	17 ± 5	12 ± 1
1/8 lb	0.5%	-	-	13 ± 3	41 ± 4	22 ± 2	8 ± 4	24 ± 3	20 ± 2
1/4 lb	0.5%	-	-	3 ± 2	32 ± 12	25 ± 2	1 ± 1	18 ± 1	16 ± 1
1/2 lb	0.5%	-	-	4 ± 3	29 ± 8	18 ± 2	3 ± 2	16 ± 1	13 ± 1
3/4 lb	0.5%	-	-	1 ± 1	25 ± 3	20 ± 2	1 ± 1	12 ± 4	12 ± 1
1 lb	0.5%	-	-	2 ± 2	19 ± 2	14 ± 2	2 ± 1	12 ± 2	11 ± 1
2 lb	0.5%	-	-	1 ± 1	19 ± 1	14 ± 1	1 ± 2	8 ± 3	7 ± 2

With fescue the addition of WK Surfactant to Embark reduced seed heads at all but the lowed rate of Embark application but had no effect on final seedhead or grass height. With bluegrass, surfactant reduced grass height by about 3 inches and seed heads by about 60%.

At this date of application, Embark + Glean + 2,4-D was less effective against bluegrass than Embark alone but, with fescue, 1/4 lb/A Embark plus 1/4 oz/A Glean in the presence of 0.5% WK and 2 lb/A 2,4-D were equivalent to about 3/4 lb/A Embark + WK Surfactant and superior to Embark alone at all rates of application.

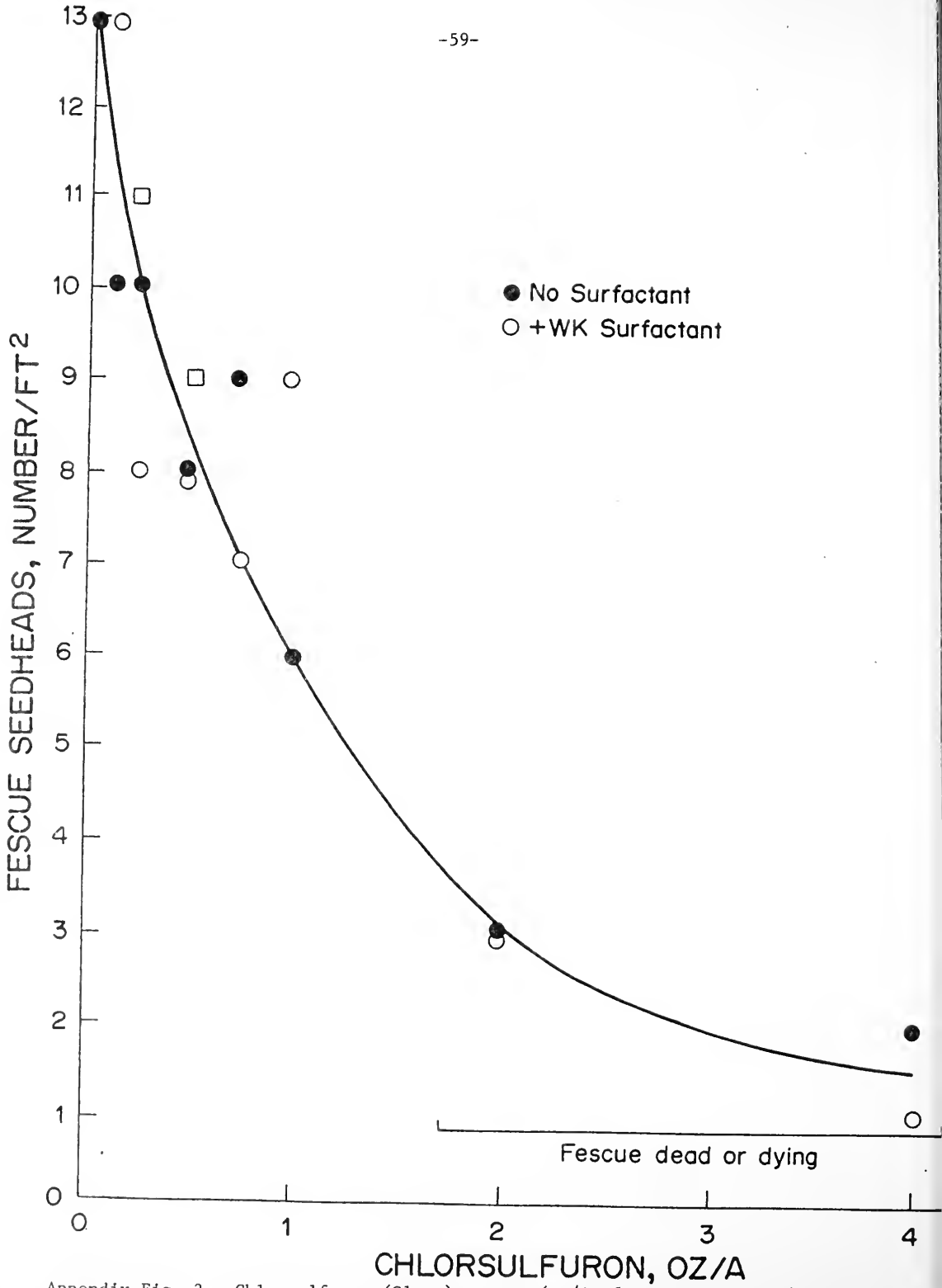
* Embark = lb/A as mefluidide; WK = % by volume of total spray mixture; Glean = oz/A of active material; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

Table 24. Weed control by Embark-WK-Glean-2,4-D combination. Applications on May 3, 1983. Evaluations on July 1, 1983. IN-126 site. Conditions as for Table 23.

Amount*				Weeds/100 ft^2								
Embark	WK	Glean	2,4-D	Buckhorn Plantain	Dandelion	Wild Carrot	Black Medic	Red Clover	White Clover	Thistle	Other Composites	Total Weeds
-	-	-	-	30	20	28	32				14	124
1/4 lb	0.5%	1/4 oz	2 lb	8	2							10**
1/8 lb	±0.5%	-	-	15	3	12	12	23	4	1	10	80
1/4 lb	±0.5%	-	-	40	12	17	46	5	10	1	2	133
1/2 lb	±0.5%	-	-	15	19	12	14	8	16	2	28	114
3/4 lb	±0.5%	-	-	9	4	15	5	20			20	73

* Embark = lb/A as mefluidide (results include an average of treatments with and without 0.5% WK Surfactant)
WK = % by volume of total spray mixture
Glean = oz/A of active material (based on 70% active)
2,4-D = lb/A acid equivalent of the dimethylamine salt

** 92% control of all weeds



Appendix Fig. 3. Chlorsulfuron (Glean) amount (oz/A of active material) on seedhead formation in fescue. Applications were on May 4, 1983. Evaluations were on June 23, 1983. IN-126 site. The surfactant was present as 0.5% of the total spray mixture.

Table 25. Glean amount (oz/A as active material) on seedhead formation and growth of fescue and bluegrass. Applications on May 4, 1983. Evaluations on June 22, 1983. IN-126 site. Plots were 6' X 7.5' in triplicate. Results are averages from the 3 replicates ± standard deviations. Initial heights; fescue 11 ± 1 inches, bluegrass 7 ± 1 inches.

Amount*				Fescue			Bluegrass		
				Seedheads		Blade	Seedheads		Blade
Embark	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	13 ± 3	47 ± 4	27 ± 4	1.5±0.5	25 ± 5	19 ± 1
1/2 lb	0.5%	-	2 lb	5 ± 2	30 ± 3	23 ± 2	0.5±1	16	15 ± 1
1/4 lb	0.5%	1/4 oz	2 lb	2 ± 1	20 ± 5	18 ± 4	0 ± 0	13 ± 1	9 ± 0
-	-	1/8 oz	-	10 ± 4	24 ± 7	21 ± 1	0 ± 0		14 ± 0
-	-	1/4 oz	-	10 ± 5	31 ± 7	22 ± 3	1 ± 1	22 ± 1	15 ± 0
-	-	1/2 oz	-	8 ± 2	25 ± 2	22 ± 0	1 ± 1	21 ± 1	16 ± 2
-	-	3/4 oz	-	9 ± 1	25 ± 2	19 ± 1	0 ± 1	20 ± 0	15 ± 1
-	-	1 oz	-	6 ± 3	22 ± 4	16 ± 1	2 ± 1	20 ± 2	15 ± 1
-	-	2 oz**	-	3 ± 2	19 ± 5	13 ± 2	1 ± 1	14 ± 3	13 ± 3
-	-	4 oz**	-	1 ± 2	16 ± 1	11 ± 1	1 ± 1	13 ± 5	12 ± 4
-	0.5%	1/8 oz	-	14 ± 1	31 ± 4	22 ± 1	4 ± 4	17 ± 0	17 ± 0
-	0.5%	1/4 oz	-	8 ± 3	24 ± 3	21 ± 3	3 ± 3	23 ± 2	15 ± 5
-	0.5%	1/2 oz	-	8 ± 1	24 ± 1	19 ± 2	3 ± 1	20 ± 4	15 ± 3
-	0.5%	3/4 oz	-	7 ± 2	24 ± 5	18 ± 1	1 ± 1	19 ± 1	16 ± 1
-	0.5%	1 oz	-	9 ± 6	24 ± 3	18 ± 2	2 ± 1	20 ± 2	15 ± 3
-	0.5%	2 oz**	-	3 ± 2	21 ± 4	16 ± 2	5 ± 4	18 ± 1	13 ± 2
-	0.5%	4 oz**	-	1 ± 1	15 ± 2	11 ± 1	2 ± 2	16 ± 0	11 ± 3

No obvious benefit of surfactant with Glean at any rate of application.

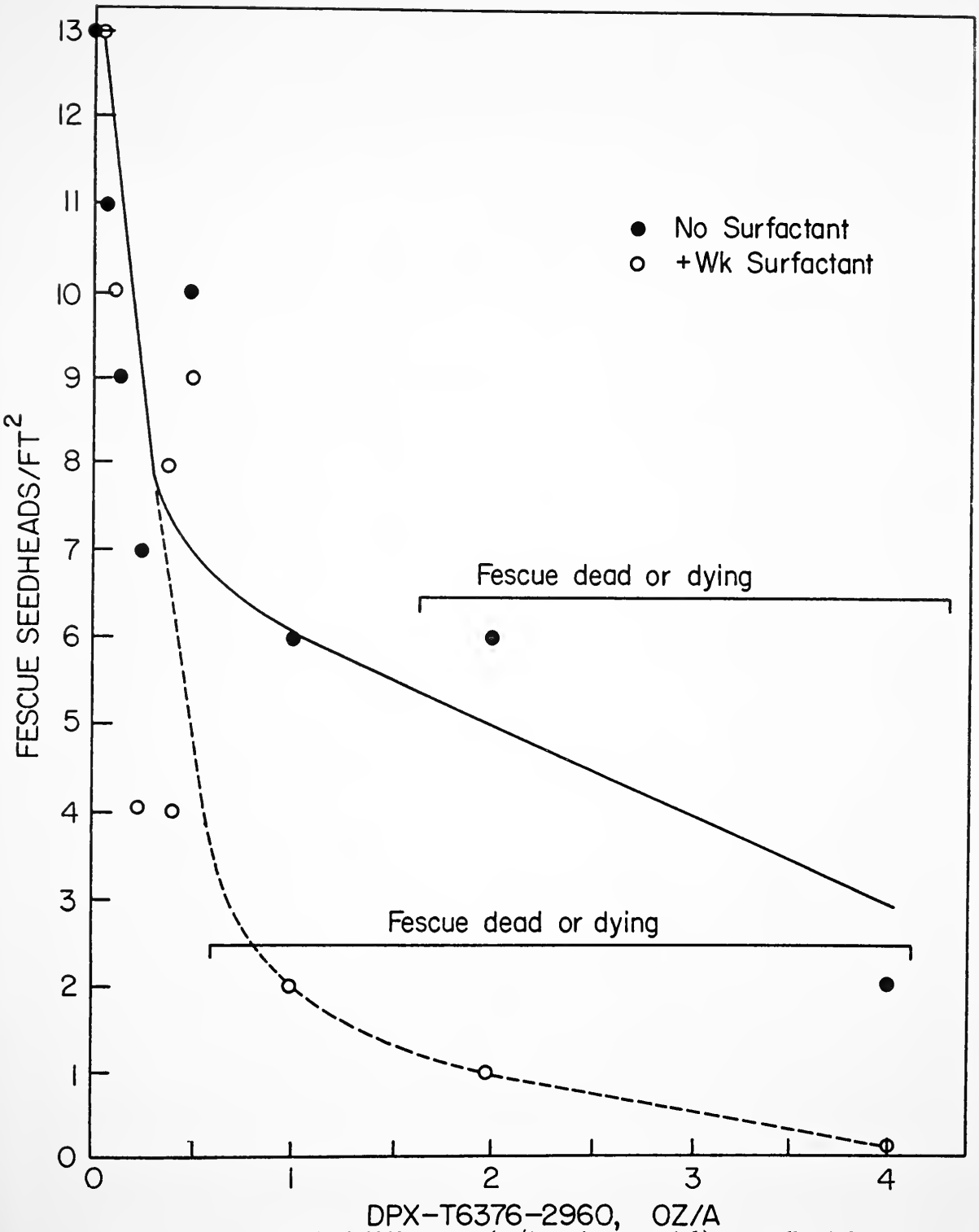
* Embark = lb/A as mefluidide; WK = % by volume of total spray mixture; Glean = oz/A of active material; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

** Strong phytotoxicity. Grass appears dead or dying.

Table 26. Glean amount (oz/A as active material) on control of broadleaf weeds. Applications on May 4, 1983. Evaluations on June 22, 1983. IN-126 site. Plots were 6' X 7.5' in triplicate.

Amount*				Weeds/100 ft^2		
Embark	WK	Glean	2,4-D	Common milkweed	Total other*	Total weeds
-	-	-	-	2	10	12
1/2 lb	0.5%	-	2 lb	1	9	10
1/4 lb	0.5%	1/4 oz	2 lb	2	9	11
-	-	1/8 oz	-		10	10
-	-	1/4 oz	-		15	15
-	-	1/2 oz	-	1	7	8
-	-	3/4 oz	-	2	2	4
-	-	1 oz	-			0
-	-	2 oz	-		3	3
-	-	4 oz	-			0
-	0.5%	1/8 oz	-	2	2	4
-	0.5%	1/4 oz	-		1	1
-	0.5%	1/2 oz	-	5	12	17
-	0.5%	3/4 oz	-	3	6	9
-	0.5%	1 oz	-		2	2
-	0.5%	2 oz	-		1	1
-	0.5%	4 oz	-		1	1

* Consisted of ground cherry, canada thistle, composites and bull nettle--mostly 2,4-D resistant species. The weed population was really too sparse and too valuable to provide definitive results.



Appendix Fig. 4. DPX-T6376-2960 amount (oz/A active material) on seedhead formation in fescue. Applied May 5, 1983. Evaluated June 23, 1983. IN-126 test area. The surfactant was present as 0.5% of the total spray mixture. Initial height of fescue 12 + 1 inches.

Table 27. DPX-T6376-2960 amount (oz/A active ingredient) on seedhead formation, growth and broadleaf weeds. Applications on May 5, 1983. Evaluations on June 23, 1983. IN-126 test site. Plots were 6' X 7.5' in triplicate. Results are averages from the 3 replicates ± standard deviations. Initial heights; fescue 12 ± 1 inches, bluegrass 7 ± 1 inches.

Amount*				Fescue			Bluegrass			
				Seedheads		Blade	Seedheads		Blade	Weeds
Embark	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per 90
-	-	-	-	25 ± 4	48 ± 3	26 ± 3	2 ± 1	26 ± 6	21 ± 4	13
1/2 lb	0.5%	-	2 lb	5 ± 2	35 ± 7	20 ± 2	2 ± 2	17 ± 1	16 ± 1	0
1/4 lb	0.5%	1/4 oz	2 lb	0.2±1	15 ± 3	15 ± 1	0 + 0		13 ± 1	3
-	-	1/16 oz	-	11 ± 1	39 ± 6	23 ± 3	1 ± 1	23 ± 3	17 ± 2	0
-	-	1/8 oz	-	9 ± 1	37 ± 7	21 ± 2	1 ± 0	20 ± 2	17 ± 2	1
-	-	1/4 oz	-	7 ± 3	34 ± 4	22 ± 1	3 ± 2	22 ± 3	19 ± 3	0
-	-	3/8 oz	-	8 ± 1	31 ± 5	21 ± 1	1 ± 1	24 ± 1	18 ± 1	1
-	-	1/2 oz	-	10 ± 3	25 ± 2	21 ± 1	2 ± 2	17 ± 2	16 ± 1	0
-	-	1 oz	-	6 ± 5	21 ± 4	18 ± 3	4 ± 2	18 ± 1	16 ± 2	0
-	-	2 oz	-	6 ± 1	19 ± 1	14 ± 2	3 ± 2	16 ± 1	14 ± 2	1
-	-	4 oz	-	2 ± 2	18 ± 2	13 ± 1	3 ± 1	15 ± 5	12 ± 2	0
-	0.5%	1/16 oz	-	13 ± 5	35 ± 4	22 ± 2	2 ± 1	23 ± 4	19 ± 1	0
-	0.5%	1/8 oz	-	10 ± 4	33 ± 4	21 ± 3	1 ± 0	17 ± 2	19 ± 1	0
-	0.5%	1/4 oz	-	4 ± 3	23 ± 2	19 ± 1	1 ± 0	18 ± 1	16 ± 1	4
-	0.5%	3/8 oz	-	4 ± 2	27 ± 4	21 ± 1	1 ± 1	20 ± 0	15 ± 1	3
-	0.5%	1/2 oz	-	9 ± 7	25 ± 1	20 ± 1	4 ± 1	17 ± 1	18 ± 1	1
-	0.5%	1 oz	-	2 ± 2	16 ± 1	15 ± 0	3 ± 1	15 ± 0	16 ± 1	0
-	0.5%	2 oz	-	1 ± 1	15 ± 0	13 ± 2	1 ± 0	13 ± 1	12 ± 2	0
-	0.5%	4 oz	-	0 ± 0	15 ± 2	13 ± 2	1 ± 1	12 ± 1	10 ± 2	0

Effect of surfactant seen only at near phytotoxic and phytotoxic rates of applicatio (See Fig. 4). Weed population insufficient to permit accurate evaluation.

* Embark = lb/A as mefluidide; WK = % by volume of total spray mixture; Glean = oz/A of active material; DPX = oz/A of active material; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

Table 28. Comparison of Embark + Surfactant + 2,4-D with Embark + Surfactant + 2,4-D supplemented with Glean. IN-126 test area. Applied May 5, 1983. Evaluation on May 21, 1983. 3' X 6' plots. Initial heights; fescue 9 ± 1 inches, bluegrass 7 ± 1 inches.

Amount*				Fescue			Bluegrass		
				Seedhead		Blade	Seedhead		Blade
Embark	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	24 ± 2	27 ± 2	14 ± 1	10 ± 2	17 ± 2	13 ± 1
1/2 lb	0.5%	-	2 lb	2 ± 2	16 ± 1	11 ± 1	6 ± 2	15 ± 1	8 ± 1
1/4 lb	0.5%	1/4 oz	2 lb	0 ± 0		10 ± 1	3 ± 2	9 ± 2	7 ± 1

* Embark = lb/A as mefluidide
WK = % by volume of total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

1/4 lb/A of Embark as mefluidide was superior when supplemented with 1/4 oz/A of Glean to 1/2 lb/A Embark unsupplemented in the mixture with WK Surfactant and 2,4-D amine.

Table 29. Comparison of XM-12, WK and X-77 Surfactants in combination with Embark, Glean and 2,4-D. In-126 test area. Applied May 8, 1983 with evaluation on June 18. 3' X 15' plots in triplicate between ditch and edge of golf course. Initial height; fescue 10 ± 1 inches, bluegrass 6 ± 1 inches.

Amount*						Fescue			Bluegrass			Orchard grass		
						Seedheads		Blade	Seedheads		Blade	Seedheads		Blade
Embark	XM-12	X-77	WK	Glean	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	Per ft^2	Height	Height
-	-	-	-	-	-	4.5±0.4	43 ± 2	19 ± 1	0.45±0.05	19 ± 2	9 ± 1	0.3±0.1	34 ± 1	17 ± 2
1/8 lb	0.5%	-	-	1/8 oz	1/2 lb	0.1±0.02	17 ± 2	11 ± 1	0.2±0.04	11 ± 3	8 ± 1	0.2±0.2	25 ± 5	13 ± 1
1/8 lb	-	0.5%	-	1/8 oz	1/2 lb	0.12±0.02	15 ± 1	11 ± 1	0.13±0.02	11 ± 3	8 ± 1	0.02±0.02	14 ± 3	13 ± 1
1/8 lb	-	-	0.5%	1/8 oz	1/2 lb	0.04±0.02	12 ± 3	10 ± 1	0.12±0.01	9 ± 2	6 ± 1			

* Embark = lb/A as mefluidide
XM-12, X-77 and WK = % by volume of total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

No significant differences among the 3 surfactants. No particular advantage to the use of XM-12. Comparing WK and X-77, WK was slightly superior in this test.

1/8 lb/A of Embark + 1/8 lb Glean insufficient for control of seedhead formation in orchard grass but close.

Table 30. Broadleaf weed control by Embark, Glean and 2,4-D (1/2 lb/A) comparing XM-12, WK and X-77 Surfactants. IN-126 test area. Applied May 8, 1983. Evaluations on June 18, 1983. 3' X 15' plots in triplicate between ditch and edge of golf course.

Amount*						Weeds per 100 ft^2									
Embark	XM-12	X-77	WK	Glean	2,4-D	Plantain	Red Clover	Dandelion	Common Milkweed	White Clover	Wild Carrot	Black Medic	Other Composites	Total Weeds	% Cont.
-	-	-	-	-	-	105	21	8	0	18	13	4	7	176	0
1/8 lb	0.5%	-	-	1/8 oz	1/2 lb	79	0	5	1	4	0	0	4	93	47%
1/8 lb	-	0.5%	-	1/8 oz	1/2 lb	59	0	16	2	1	1**	0	1	80	55%
1/8 lb	-	-	0.5%	1/8 oz	1/2 lb	43	0	11	0	1	1**	0	1	57	68%

* Embark = lb/A as mefluidide
XM-12, X-77 and WK = % by volume of total spray mixture
Glean = oz/A of active material
2,4-D lb/A of acid equivalent of the dimetylamine salt

** dying

1/2 lb/A of 2,4-D plus 1/8 oz/A of Gelan was insufficient for control of plantain and dandelion. Plantain sick but not dying. Glean at 1/8 oz/A plus 2,4-D 1/2 lb/A did the job on wild carrot in this test.

Table 31. Combinations of Embark and Glean in the presence of 0.5% WK Surfactant and 2 lb/A 2,4-D on seedhead formation in fescue and bluegrass. IN-126 test area. Application on May 9, 1983. Evaluations on June 15, 1983. Triplicate 7.5' X 3' plots. Averages ± standard deviations among replicates. Initial heights; fescue 11 ± 1 inches, bluegrass 8 ± 1 inches.

Amount*					Fescue		Bluegrass		
					Seedheads		Seedheads		
Embark	WK	Glean	DPX	2,4-D	Per ft^2	Height	Per ft^2	Height	Cost/A
-	-	-	-	-	17 ± 1	46 ± 0	4 ± 1	17 ± 1	-
1/2 lb	0.5%	-	-	2 lb	7 ± 1	24 ± 3	3 ± 2	14 ± 1	$30
1/4 lb	0.5%	1/4 oz	-	2 lb	0 ± 0	14 ± 2	2 ± 1	10 ± 4	$20
1/8 lb	0.5%	3/4 oz	-	2 lb	*** 0 ± 0	15 ± 2	3 ± 1	14 ± 3	$20
1/8 lb	0.5%	1/2 oz	-	2 lb	0 ± 0	14 ± 2	3 ± 2	11 ± 1	$16
1/8 lb	0.5%	-	1/4 oz	2 lb	*** 0 ± 0	13 ± 1	3 ± 1	10 ± 1	$16

* Embark = lb/A as mefluidide
WK = % by volume in total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt.

** Based on the following estimates for costs of materials

Glean = $15/oz
DPX = $30/oz
Embark = $55/lb
2,4-D amine = $2.25/lb

*** Strong phytotoxicity on two of three replicates on June 24. Still no seedheads.

By far the best treatment in terms of performance and cost was 1/8 lb Embark + 1/2 oz Glean + WK Surfactant + 2 lb 2,4-D per acre. Results were equivalent to 1/4 lb/A Embark + 1/4 oz/A Glean + WK surfactant + 2 lb/A 2,4-D. Both treatments were superior to the standard treatment of 1/2 lb/A Embark + WK + 2 lb/A of 2,4-D.

Table 32. Combinations of Embark and Glean in the presence of 0.5% WK Surfactant and 2 lb/A 2,4-D on control of broadleaf weeds. IN-126 test area. Applications on May 9, 1983. Evaluations on July 3, 1983. Triplicate 3' X 7.5' plots.

Amount*					Weeds per 60 ft^2								
Embark	WK	Glean	DPX	2,4-D	Plantain	Red Clover	Black Medic	Wild Carrot	Thistle	Common Milkweed	Whorled Milkweed	Ground Cherry	Total Weeds
-	-	-	-	-	5	6	4	4	1	1	9	1	31
1/2 lb	0.5%	-	-	2 lb						5		1	6
1/4 lb	0.5%	1/4 oz	-	2 lb						6		8	14
1/8 lb	0.5%	3/4 oz	-	2 lb						8	6	4	18
1/8 lb	0.5%	1/2 oz	-	2 lb						2	3	8	13
1/8 lb	0.5%	-	1/4 oz	2 lb						5		10	15

* Embark = lb/A as mefluidide
WK = % by volume in total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimetnylamine salt

100% control of all common 2,4-D-suceptible weeds by all treatments. No apparent control of common milkweed, whorled milkweed or ground cherry.

Table 33. DPX-T6376-2960 in combination with varying rates of WK Surfactant. IN-126 test area. Applications on May 10, 1983. Evaluations on June 15 for fescue and bluegrass and on July 2 for weed control. Triplicate 3' X 7.5' plots. Initial heights; fescue 12 ± 1 inches, bluegrass 9 ± 2 inches.

Amount*		Fescue		Bluegrass		Weeds pe
WK	DPX	Seedheads/ft^2	Seedhead height	Seedheads/ft^2	Seedhead height	60 ft
-	-	14 ± 1	44 ± 1	2 ± 2	28 ± 3	14
0.5%	-	15 ± 1	43 ± 3	2 ± 2	29 ± 3	15
3%	-	13 ± 2	44 ± 3	3 ± 2	26 ± 2	**
-	1/4 oz/A	9 ± 1	35 ± 3	1 ± 1	22 ± 9	6
0.5%	1/4 oz/A	9 ± 1	30 ± 2	1 ± 1	23 ± 2	5
3%	1/4 oz/A	9 ± 2	25 ± 3	2 ± 2	22 ± 2	10

* WK = % by volume of total spray mixture
DPX-T6376-2960 as oz/A active material

** Heavy infestation of bindweed in all plots (not counted)

Interaction with surfactant only on height of fescue seed heads.
Broadleaf weed species present in DPX-treated plots were bindweed, common milkweed, motherwort (a perennial mint) and composites (goldenrod and asters). Controlled by DPX (present in untreated plots and plots receiving detergent only) were wild parsnip, wild carrot and common thistle.

Table 34. Embark plus Glean with and without 2,4-D and comparison of surfactants. IN-126 test area. Applications were on May 11, 1983. Evaluations of grass were on June 17 and of weeds on July 3, 1983. 3' X 7.5' plots. Initial heights; fescue 11 ± 1 inches, bluegrass 8 ± 2 inches.

Amount*						Fescue		Bluegrass		Weeds per 60 ft^2	
						Seedheads		Seedheads			
Embark	XM-12	X-77	WK	Glean	2,4-D	Per ft^2	Height	Per ft^2	Height	Total	Common Milkweed
-	-	-	-	-	-	16 ± 1	45 ± 1	4 ± 1	27 ± 3	38**	6
1/4 lb	0.5%	-	-	1/4 oz	2 lb	0 ± 0	15 ± 2	7 ± 3	16 ± 3	7	7
1/4 lb	-	0.5%	-	1/4 oz	2 lb	0 ± 1	15 ± 2	8 ± 4	16 ± 3	3	3
1/4 lb	-	-	0.5%	1/4 oz	2 lb	0 ± 1	15 ± 2	9 ± 9	17 ± 5	4	4
1/4 lb	-	-	-	1/4 oz	2 lb	2 ± 1	24 ± 3	4 ± 2	19 ± 1	1	1
1/4 lb	-	-	-	1/4 oz	-	4 ± 2	23 ± 6	6 ± 6	16 ± 1	5	5

No significant effect among the different surfactants, all three more effective than no detergent on fescue. No effect of 2,4-D on Embark + Glean combination.

* Embark = lb/A as mefluidide
XM-12, X-77 and WK = % by volume in total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

** Weeds controlled mostly legumes (red and white clover, bird's foot trefoil and black medic)
The only weed remaining in the treated plots were common milkweed as shown by the table above.

Table 35. Varying rates of Embark, Glean and DPX-T6376-2960 in combination with X-77 Surfactant and 2,4-D. IN-126 test area. Applied May 12 and 13 1982. Rained about 2 hours after the materials were applied both days. Evaluations on June 27, 1983. 3' X 7.5' plots in triplicate. Initial height of fescue 16 ± 1 inches. Essentially no bluegrass present.

Amount*					Fescue	
Embark	X-77	Glean	DPX	2,4-D	Seed Heads/ft^2	Seed Head Height**
-	-	-	-	-	15 ± 1	35 ± 1
1/16 lb	0.5%	1/8 oz	-	2 lb	14 ± 1	33 ± 1
1/16 lb	0.5%	1/4 oz	-	2 lb	14 ± 2	33 ± 1
1/16 lb	0.5%	1/2 oz	-	2 lb	14 ± 2	33 ± 1
1/16 lb	0.5%	-	1/16 oz	2 lb	12 ± 1	35 ± 1
1/16 lb	0.5%	-	1/8 oz	2 lb	12 ± 1	36 ± 1
1/16 lb	0.5%	-	1/4 oz	2 lb	13 ± 3	33 ± 3
1/8 lb	0.5%	1/8 oz	-	2 lb	9 ± 4	27 ± 1
1/8 lb	0.5%	1/4 oz	-	2 lb	7 ± 2	24 ± 1
1/8 lb	0.5%	1/2 oz	-	2 lb	8 ± 5	21 ± 3
1/8 lb	0.5%	-	1/16 oz	2 lb	10 ± 3	29 ± 2
1/8 lb	0.5%	-	1/8 oz	2 lb	9 ± 1	29 ± 4
1/8 lb	0.5%	-	1/4 oz	2 lb	9 ± 5	26 ± 4
1/4 lb	0.5%	1/8 oz	-	2 lb	6 ± 4	25 ± 3
1/4 lb	0.5%	1/4 oz	-	2 lb ***	6 ± 0	24 ± 2
1/4 lb	0.5%	1/2 oz	-	2 lb	6 ± 3	25 ± 3
1/4 lb	0.5%	-	1/16 oz	2 lb	12 ± 2	32 ± 2
1/4 lb	0.5%	-	1/8 oz	2 lb	7 ± 4	29 ± 4
1/4 lb	0.5%	-	1/4 oz	2 lb ***	5 ± 2	22 ± 2

* Embark = lb/A as mefluidide; X-77 = % by volume in total spray mixture; Glean and DPX-T6376-2960 (DPX) = oz/A of active material; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

** Height in inches

*** Most impressive treatments (See Table 36 for summary).

Table 36. Summary of varying rates of Embark, Glean and DPX-T-6376-2960 in combination with X-77 Surfactant and 2,4-D on fescue. IN-126 test area. Applied May 12 and 13, 1982. Rained about 2 hours after the materials were applied both days. Evaluations on June 27, 1983. 3' X 7.5' plots in triplicate. Initial height of fescue 16 ± 1 inches. Essentially no bluegrass present. From Table 35.

Amount*					Fescue	
Embark	X-77	Glean	DPX	2,4-D	Seed Heads/ft^2	Seed Head Height**
-	-	-	-	-	15 ± 1	35 ± 1
1/16 lb	0.5%	all treatments		2 lb	13 ± 1	34 ± 1
1/8 lb	0.5%	all treatments		2 lb	9 ± 1	26 ± 3
1/4 lb	0.5%	all treatments		2 lb	7 ± 3	26 ± 4
all rates	0.5%	1/8 oz	-	2 lb	10 ± 4	28 ± 4
all rates	0.5%	1/4 oz	-	2 lb	9 ± 4	27 ± 5
all rates	0.5%	1/2 oz	-	2 lb	9 ± 4	27 ± 6
all rates	0.5%	-	1/16 oz	2 lb	11 ± 1	32 ± 3
all rates	0.5%	-	1/8 oz	2 lb	9 ± 3	31 ± 4
all rates	0.5%	-	1/4 oz	2 lb	9 ± 4	27 ± 5

* Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
Glean and DPX-T6376-2960 = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

** Height in inches

Reduction of seed head per ft^2 proportional to rate of Embark but except for 1/16 oz/A of DPX was independent of Glean or DPX amount (1/16 oz/A = 1/8 oz/A = 1/4 oz/A of Glean and 1/8 oz/A = 1/4 oz/A of DPX). Glean and DPX gave equivalent results.

Note: Rained 2 hours after treatments were applied so that effectiveness was reduced compared to other tests where rain was delayed for longer periods.

Table 37. Weed control from varying rates of Glean and DPX in the presence of 1/4 lb/A Embark as mefluidide and 0.5% X-77 plus 2 lb/A 2,4-D amine. IN-126 test area. Applied May 12, 1983. Rained about 2 hours after the materials were applied. Evaluations on July 5, 1983. 3' X 7.5' plots in triplicate. Results are averages ± standard deviations.

	Amount*				Weeds per 20 ft^2			
Embark	X-77	Glean	DPX	2,4-D	Carrot	Dandelion	Thistle + Milkweed	Total
-	-	-	-	-	3 ± 2	2 ± 2	1 ± 2	6 ± 2
1/4 lb	0.5%	1/8 oz	-	2 lb	3 ± 5	0 ± 0	1 ± 2	4 ± 6
1/4 lb	0.5%	1/4 oz	-	2 lb	1 ± 1	1 ± 2	0 ± 1	2 ± 1
1/4 lb	0.5%	1/2 oz	-	2 lb	0 + 0	0 ± 0	1 ± 2	1 + 2
1/4 lb	0.5%	-	1/16 oz	2 lb	1 ± 0	1 ± 1	0 ± 1	2 ± 0
1/4 lb	0.5%	-	1/8 oz	2 lb	1 ± 1	0 ± 0	1 ± 1	2 ± 1
1/4 lb	0.5%	-	1/4 oz	2 lb	3 ± 5	0 ± 0	0 ± 1	3 ± 5

* Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

Despite the rain following treatment, the combinations containing 1/4 or 1/2 oz/A of Glean gave reasonable control of wild carrot. Overall, the treated plots averaged 2.3 ± 1.0 weeds/20 ft^2 or 62% compared to control.

Table 38. Weed control from varying rates of Glean and DPX in the presence of 1/8 lb/A Embark as mefluidide and 0.5% X-77 plus 2 lb/A 2,4-D amine. IN-126 test area. Applied May 13, 1983. Rained about 2 hours after the materials were applied. Evaluations on July 5, 1983. 3' X 7.5' plots in triplicate. Results are averages ± standard deviations.

Amount*					Weeds per 20 ft^2				
Embark	X-77	Glean	DPX	2,4-D	Carrot	Dandelion	Plantain	Thistle + Milkweed	Total
-	-	-	-	-	3 ± 4	3 ± 3	2 ± 3	0 ± 1	8 ± 6
1/8 lb	0.5%	1/8 oz	-	2 lb	1 ± 2	1 ± 2	0 ± 0	0 + 0	2 ± 2
1/8 lb	0.5%	1/4 oz	-	2 lb	1 ± 1	1 ± 3	0 ± 0	0 ± 0	2 ± 2
1/8 lb	0.5%	1/2 oz	-	2 lb	0 ± 0	1 ± 1	0 ± 0	0 ± 0	1 ± 1
1/8 lb	0.5%	-	1/16 oz	2 lb	0 ± 0	1 ± 1	0 ± 0	0 ± 1	1 ± 1
1/8 lb	0.5%	-	1/8 oz	2 lb	0 ± 0	0 ± 0	0 ± 0	2 ± 3	2 ± 3
1/8 lb	0.5%	-	1/4 oz	2 lb	0 ± 1	0 ± 0	0 ± 0	0 ± 0	0 ± 1

* Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

Overall, the treated plots averaged 1.3 ± 0.7 weeds per 20 ft^2 or 84% control.

Table 39. Weed control from varying rates of Glean and DPX in the presence of 1/16 lb/A Embark as mefluidide and 0.5% X-77 plus 2 lb/A 2,4-D amine. IN-126 test area. Applied May 13, 1983. Rained about 2 hours after the materials were applied. Evaluations on July 5, 1983. 3' X 7.5' plots in triplicate. Results are averages ± standard deviations.

		Amount*			Weeds per 20 ft^2			
Embark	X-77	Glean	DPX	2,4-D	Carrot	Dandelion	Thistle + Milkweed	Total
-	-	-	-	-	0 ± 1	7 ± 8	2 ± 3	9 ± 10
1/16 lb	0.5%	1/8 oz	-	2 lb	0 ± 0	2 ± 3	0 ± 0	2 ± 3
1/16 lb	0.5%	1/4 oz	-	2 lb	0 ± 0	3 ± 7	0 ± 0	3 ± 7
1/16 lb	0.5%	1/2 oz	-	2 lb	0 ± 0	0 ± 0	0 + 0	0 ± 0
1/16 lb	0.5%	-	1/16 oz	2 lb	0 ± 0	1 ± 1	0 ± 0	1 ± 1
1/16 lb	0.5%	-	1/8 oz	2 lb	0 ± 0	1 ± 2	1 ± 2	2 ± 2
1/16 lb	0.5%	-	1/4 oz	2 lb	0 ± 0	2 ± 3	0 ± 0	2 ± 3

* Embark = lb/A as mefluidide
X-77 = % by volume of total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent as the dimethylamine salt

Overall, the treated plots averaged 1.7 ± 1.0 weeds per 20 ft^2 or 81% control.

Table 40. Varying rates of Glean and DPX-T6376-2960 in the presence of 1/16 lb/A of Embark as mefluidide and 0.5% X-77 Surfactant plus 1 lb/A 2,4-D on seedhead height and number in fescue. IN-126 test site. Applied May 16, 1983. Very light rain 2 1/2 hours following application. Evaluations on June 24, 1983. 3' X 7.5' plots in triplicate. Initial height of fescue 23 ± 1 inches with 6 ± 4 seedheads per ft^2 already formed. Results are averages of the three replications ± standard deviations.

Amount*					Fescue			
					Seedheads		Seedhead	
Embark	X-77	Glean	DPX	2,4-D	Per ft^2	Change	Height**	Change**
-	-	-	-	-	16 ± 1	10	41 ± 1	18
1/2 lb	0.5%	-	-	2 lb	9 ± 2	3	33 ± 4	10
-	0.5%	1/4 oz	-	-	12 ± 1	6	33 ± 1	10
-	0.5%	1/2 oz	-	-	11 ± 5	5	31 ± 3	8
1/16 lb	0.5%	1/8 oz	-	1 lb	11 ± 5	5	30 ± 3	7
1/16 lb	0.5%	3/16 oz	-	1 lb	10 ± 4	4	32 ± 2	9
1/16 lb	0.5%	1/4 oz	-	1 lb	9 + 3	3	29 ± 4	6
1/16 lb	0.5%	-	1/16 oz	1 lb	8 ± 3	2	31 ± 2	8
1/16 lb	0.5%	-	1/8 oz	1 lb	8 ± 1	2	31 ± 1	8
1/16 lb	0.5%	-	3/16 oz	1 lb	6 ± 2	0	27 ± 2	4

* Embark = lb/A as mefluidide
X-77 = % by volume of the total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent as the dimethylamine salt

** Inches

Change based on an initial height of 23 ± 1 inches and 6 ± 4 seedheads/ft^2.

1/16 lb/A Embark + 1/8 oz/A Glean or 1/16 lb/A Embark + 1/16 oz/A DPX were equivalent to 1/2 lb/A of Embark alone (in the presence of X-77 and 2,4-D).

Weeds were too sparse to provide accurate data (about 1/20ft^2 in both treated and untreated plots).

Table 41. Varying rates of Embark, Glean and 2,4-D in the presence of X-77 surfactant. IN-126 test area. Application on May 17, 1983. Evaluation on June 15, 1983. 3' X 7.5' plots in triplicate. Initial height of fescue was 16.5 ± 2.1 inches with 4-5 seedheads/ft^2. Bluegrass was 12.5 ± 1.9 inches with 6 ± 3 seedheads/ft^2. Results are averages of the three experiments ± standard deviations.

Amount*				Fescue		Bluegrass	
Embark	X-77	Glean	2,4-D	Seedheads Per ft^2	Grass Height**	Seedheads Per ft^2	Grass Height**
Initial (time of application)				4.5 ± 0.5	16.5 ± 2.1	6 ± 3	12 ± 2
-	-	-	-	15 ± 3	42 ± 8	8 ± 2	24 + 4
-	0.5%	-	2 lb	14 ± 1	39 ± 1	7 ± 3	23 ± 1
1/8 lb	0.5%	1/4 oz	-	4 ± 3	15 ± 1	4 ± 3	15 ± 3
1/8 lb	0.5%	1/4 oz	1 lb	5 ± 1	18 ± 4	5 ± 1	15 ± 2
1/8 lb	0.5%	1/8 oz	-	5 ± 3	17 ± 1	5 ± 4	12 ± 2
1/8 lb	0.5%	1/8 oz	1 lb	3 ± 1	17 ± 3	5 ± 2	12 ± 2

* Embark = lb/A as mefluidide
X-77 = % by volume of the total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

** Inches

All combinations of Embark at 1/8 lb/A plus Glean (1/8 or 1/4 oz per acre) with or without 1 lb/A 2,4-D prevent further grass development (compare with initial values in table). No indications of serious negative interactions with 2,4-D.

Table 42. Weed control from combinations of Glean and 2,4-D in the presence or absence of 1/8 lb/A Embark as mefluidide. IN-126 test area. Applications on May 17, 1983. Evaluations on July 7, 1983. 3' X 7.5' plots in triplicate. Results are averages of the three replicates ± standard deviations.

Amount*				Weeds/20 ft^2									
Embark	X-77	Glean	2,4-D	Buckhorn Plantain	Red Clover	Black Medic	Wild Carrot	Common Thistle	Birdsfoot Trefoil	White Clover	Dandelion	Whorled & Common Milkweed	Total Weeds
-	-	-	-	16 ± 13	21 ± 10	6 ± 8	17 ± 13		5 ± 9		1 ± 1	8 + 14	74 ± 25
-	0.5%	-	2 lb	0 ± 1	0 ± 1							2 ± 3	3 ± 1
1/8 lb	0.5%	1/4 oz	-	12 ± 7	1 ± 3		4 ± 3	1 ± 1				2 ± 1	20 ± 7
1/8 lb	0.5%	1/4 oz	1 lb	3 ± 4	1 ± 1	1 ± 1						9 ± 6	14 ± 5
1/8 lb	0.5%	1/8 oz	-	0 ± 1			2 ± 2					1 ± 3	3 ± 2
1/8 lb	0.5%	1/8 oz	1 lb	1 ± 1			1 ± 1					2 ± 3	4 ± 2

* Embark = lb/A as mefluidide
X-77 = % by volume of the total spray mixture
Glean = oz/A active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt.

Weed control from 2 lb/A 2,4-D = 96%

" " " 1/8 lb/A Embark + 1/4 or 1/8 oz/A Glean = 84%

" " " 1/8 lb/A Embark + 1/4 or 1/8 oz/A Glean + 1 lb/A 2,4-D = 88%

1 1/A 2,4-D in the mixtures with Glean is not really enough. Since inexpensive, may be better to stay with 2 lb/A.

Table 43. Varying rates of Embark, Glean and 2,4-D in the presence of X-77 surfactant. IN-126 test area. Application on May 18, 1983. Evaluation on June 15, 1983. 3' X 7.5' plots in triplicate. Initial height of was 17 ± 1 inches with 1 ± 1 seedheads/ft^2. Initial height of bluegrass was 14 ± 2 inches with 1 ± 1 seedheads/ft^2

Amount*				Fescue		Bluegrass	
Embark	X-77	Glean	2,4-D	Seedheads Per ft^2	Grass Height**	Seedheads Per ft^2	Grass Height**
Initial (time of application)				1 ± 1	17 ± 1	1 ± 1	14 ± 2
-	-	-	-	15 ± 3	42 + 4	4 ± 1	24 ± 3
-	0.5%	-	2 lb	15 ± 1	46 ± 1	4 ± 1	25 ± 1
1/16 lb	0.5%	1/6 oz	-	2 ± 1	20 ± 1	3 ± 2	20 ± 3
1/16 lb	0.5%	1/6 oz	1 lb	1 ± 0	24 ± 4	1 ± 1	19 ± 2
1/16 lb	0.5%	1/2 oz	-	1 ± 1	17 ± 1	2 ± 2	13 ± 2
1/16 lb	0.5%	1/2 oz	1 lb	1 ± 1	19 ± 2	2 ± 2	16 ± 1

* Embark = lb/A as mefluidide
X-77 = % by volume of the total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

** inches

All combinations of Embark at 1/16 lb/A plus Glean (1/6 or 1/2 oz per acre) with or without 1 lb/A 2,4-D prevented seedhead formation in fesuce and bluegrass at this late application date. 1/8 lb/A plus Glean (1/8 or 1/4 lb/A) was superior in suppressing seedhead height (compare with Table 41). Some evidence of slight antagonism from 1 lb/A 2,4-D at the low rate of Embark application (1/16 lb/A) compared with Embark at 1/8 lb/A (as mefluidide, Table 41).

Table 44. Weed control from combinations of Glean and 2,4-D in the presence or absence of 1/16 lb/A Embark as mefluidide. IN-126 Test area. Applications on May 18, 1983. Evaluation on July 3, 1983. 3' X 7.5' plots in triplicate.

Amount*				Weeds per 60 ft^2								
Embark	X-77	Glean	2,4-D	Buckhorn Plantain	Red Clover	Birdsfoot Trefoil	Black Medic	Wild Carrot	Dandelion	Thistle	Total Weeds	% Control
-	-	-	-	9	155	11	26	57	10		268	0
-	0.5%	-	2 lb	1	2	16		5			24	91
1/16 lb	0.5%	1/6 oz	-	12	3	1		30			46	83
1/16 lb	0.5%	1/6 oz	1 lb	5				5			10	96
1/16 lb	0.5%	1/2 oz	-	8				2			10	96
1/16 lb	0.5%	1/2 oz	1 lb	1				2	1	1	5	98

* Embark = lb/A as mefluidide
X-77 = % by volume of the total spray mixture
Glean = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

1/2 oz Glean equivalent to 2 lb/A 2,4-D except for buckhorn plantain which required the addition of 1 lb/A 2,4-D to the 1/2 oz/A of Glean for control. At the 1/6 oz/A rate of Glean, 1 lb/A of 2,4-D was insufficient to provide satisfactory control of buckhorn plantain.

Table 45. Effect of varying concentrations of 2,4-D, Glean and DPX-T6376-2960 on the control of wild carrot and other weeds. IN-126 test area. Applications on May 19 and 20, 1983. Evaluations on June 28, 1983. 3' X 6' plots in triplicate. Fescue height 18 ± 5 inches with 8.5 ± 3 seedheads/ft^2 (approximately 50% headed out).

Amount*			Weeds/50 ft^2						
Glean	DPX	2,4-D	Wild Carrot	Red Dandelion	Clover	Chickory	Buckhorn Plantain	Wild Parsnip	Curled Dock	Total Weeds
-	-	-	37 ± 24	12 ± 7	2 ± 2	16 ± 16	2 ± 2	0 ± 1	0 ± 1	70 ± 1
1/16 oz	-	-	24	8		2				34
1/8 oz	-	-	2	2		2				6
3/16 oz	-	-	4	2						6
1/4 oz	-	-	8	7			6			21
1/2 oz	-	-	2				9			11
3/4 oz	-	-	4	5						9
1 oz	-	-	1	8						9
-	1/32 oz	-	11	12		10	2			35
-	1/16 oz	-	9	5		2	1			17
-	3/32 oz	-	6	5						11
-	1/8 oz	-	8				1			9
-	1/4 oz	-	7							7
-	3/8 oz	-	2			1				3
-	1/2 oz	-	1				1			2
-	-	1/2 lb	4	6						10
-	-	1 lb	6	1						7
-	-	1 1/2 lb	1	1			1			3
-	-	2 lb	5				1			6
-	-	3 lb	2							2
-	-	4 lb	0							0

* Glean and DPX-T6376-2960 (DPX) = oz/A active material
2,4-D = lb/A acid equivalent of the dimethylamine salt

Rates greater than or equal to 1/8 oz/A Glean, 1/8 oz/A DPX or 1 lb/A 2,4-D gave about 90% control of weeds or greater. Carrot control was similar although the carrot escapes from the 2,4-D treatment recovered much more quickly than those from the Glean or DPX plots.

Table 46. Control of common plantain by 2,4-D. IN-126 test area. Application on June 28, 1983. Evaluation on September 2, 1983. 10' X 36' plots in duplicate. Initial counts of plantain were made at the time of treatment counting all plants present in the plots.

2,4-D, lb/A*	Common plantain/10 ft^2		% Control
	June 28, 1983	September 3, 1983	
0.5	6.2	0.05	99
1.0	13.8	0.03	100
1.5	22.2	0	100
2.0	11.1	0	100

* Acid equivalent of the dimethylamine salt

Plantain control was essentially complete even at the lowest rate of application of 2,4-D of 1/2 lb/A.

Table 47. Evaluation of DPX-&6376-2960 (DPX) on control of plantain and other weed species in the presence and absence of 0.5% WK Surfactant. IN-126 test area. Applications were on July 5, 1983 (without detergent and on July 7, 1983 (with detergent). 6' X 6' plots with no replicates. All weeds in each plot were counted at the time of treatment and on September 3, 1983.

Amount*		Weeds per 36 ft^2													
		Common Plantain		Buckhorn Plantain		Dandelion		Red Clover		White Clover		Black Medic		Total Weeds	
WK	DPX	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
-	-	53	60	0	0	7	10	8	5					68	75
-	1/8 oz/A	28	30	4	4	7	3	3	0					42	37
-	1/4 oz/A	45	56			5	1	2	0					52	57
-	1/2 oz/A	16	25			9	0	2	0					25	27
-	3/4 oz/A**	4	4	2	2	20	4							26	10
0.5%	-	4	4	22	22	8	16			8	12	8	0	50	54
0.5%	1/8 oz/A	12	12	13	8	9	0			18	0			52	20
0.5%	1/4 oz/A	4	4	5	2	5	0			7	0	4	0	25	6
0.5%	1/2 oz/A**	1	0	16	3	30	1					55	0	102	4
0.5%	3/4 oz/A**	1	0	17	5	9	0			2	0	20	0	49	5

* DPX-T6276-2960 (DPX) = oz/A active material
WK = % by volume of the total spray mixture

Without surfactant, DPX was ineffective against plantain. With surfactant, some activity was seen against plantain, especially buckhorn plantain. However, phytotoxic rates of application of 1/2 oz/A or greater were required.

Table 48. Glean Test. US 52 median between Lafayette and Indianapolis. Applied May 24 and May 26, 1983 by Chemitrol, Indianapolis. Evaluations on June 23, 1983. 7 to 7.5 mile plots.

Glean oz/A	Fescue			Bluegrass			Orchard Grass			Smooth Brome			Timothy	
	SH Ht	Bld HT	SH/Ft^2	SH Ht	Bld Ht	SH/Ft^2	SH Ht	Bld Ht	SH/Ft^2	SH Ht	Bld Ht	SH/Ft^2	SH Ht	SH/Ft^2
0	36±3	19±2	12±3	19±1	14±2	10± 2	37±5	23±2	11±2	36±6	18±2	12±2	26±5	9±3
1/4	30±6	17±3	12±1	18±2	15±1	10±1	35±2	20±2	13±3	32±4	18±2	12±3	20±3	8±6
1/2*	23±1	14±1	13±1	18±4	12±1	11±1	36±3	22±2	12±3	33±3	15±2	11±1	22±2	7±1
3/4*	23±2	15±1	12±1	14±3	12±1	11±1	29±7	14±1	12±1	31±2	16±1	12±1	21±1	9±4
1 *	19±3	14±2	13±1	14±2	12±2	11±1	23±5	16±4	11±3	26±4	15±1	12±2	23±3	3±1

Effect on fescue and bluegrass maximal at 1/2 oz/A. No effect on seedheads/ft^2. Not much effect on other species.

Key: SH Ht = Height of seedheads in inches (maximum visual).

Bld Ht = Leaf blade height (extended) of basal leaves in inches.

SH/Ft^2 = Seedheads per ft^2 of areas occupied by each particular species. Orchard grass, smooth brome and timothy were in widely scattered infestations. Seedheads were counted in the square foot area surrounding a clump consisting of each of the species present. Actual seedheads/ft^2 would be much less in proportion to their actual densities within the total median.

* Phytotoxicity noted.

Table 49. Glean Test: Weed Control. US 52 median between Lafayette and Indianapolis. Applied May 24 and May 26, 1983 by Chemitrol, Indianapolis. Evaluations on July 1, 1983. 7 to 7.5 mile plots.

	Glean oz/A	Weeds/Acre: Buckhorn Plantain	Common & Whorled Milkweed	Carrot	Clovers*	Other	Total	% Control
SOUTHBOUND 1/4 MEDIAN	0	40,455	1,305	3,480	62,240	33,010	140,890	0
	1/4	43,500	4,930	870**	13,050	6,090	68,440	51
	1/2	41,856	1,962	0	8,284	1,308	53,410	62
	3/4	49,880	870	0	0	290	51,040	64
	1	27,260	870	0	0	0	28,130	80
			Common	Whorled				
CENTER 1/2 MEDIAN	0	4,350	1,247	3,770	20,010	31,465	1,595##	62,437	0
	1/4	2,030	1,160	2,465	1,145**	870	5,800	13,470	78
	1/2	4,360	1,635	3,161	1,199**	1,635	3,488	15,478	75
	3/4	1,015	2,030	3,915	0	0	2,900	9,860	84
	1	3,045	1,160	1,160	0	0	1,305	6,670	89
NORTHBOUND 1/4 MEDIAN (UNTREATED)	0	52,080	124	1,302	6,262	82,398***	27,472**	169,648	

*** Clovers included Red Clover (30,566), Sweet Clover (18,042), White Clover (10.106), Alsike Clover (434) and Black Medic (23,250).

** Other weeds included Common Plantain (2,124), Dock (62), Wild Parsnip (62), Ground Cherry (62), Chickory (14,174) and other Composites (2,604)

* Red, Sweet, White and Alsike Clovers plus Black Medic

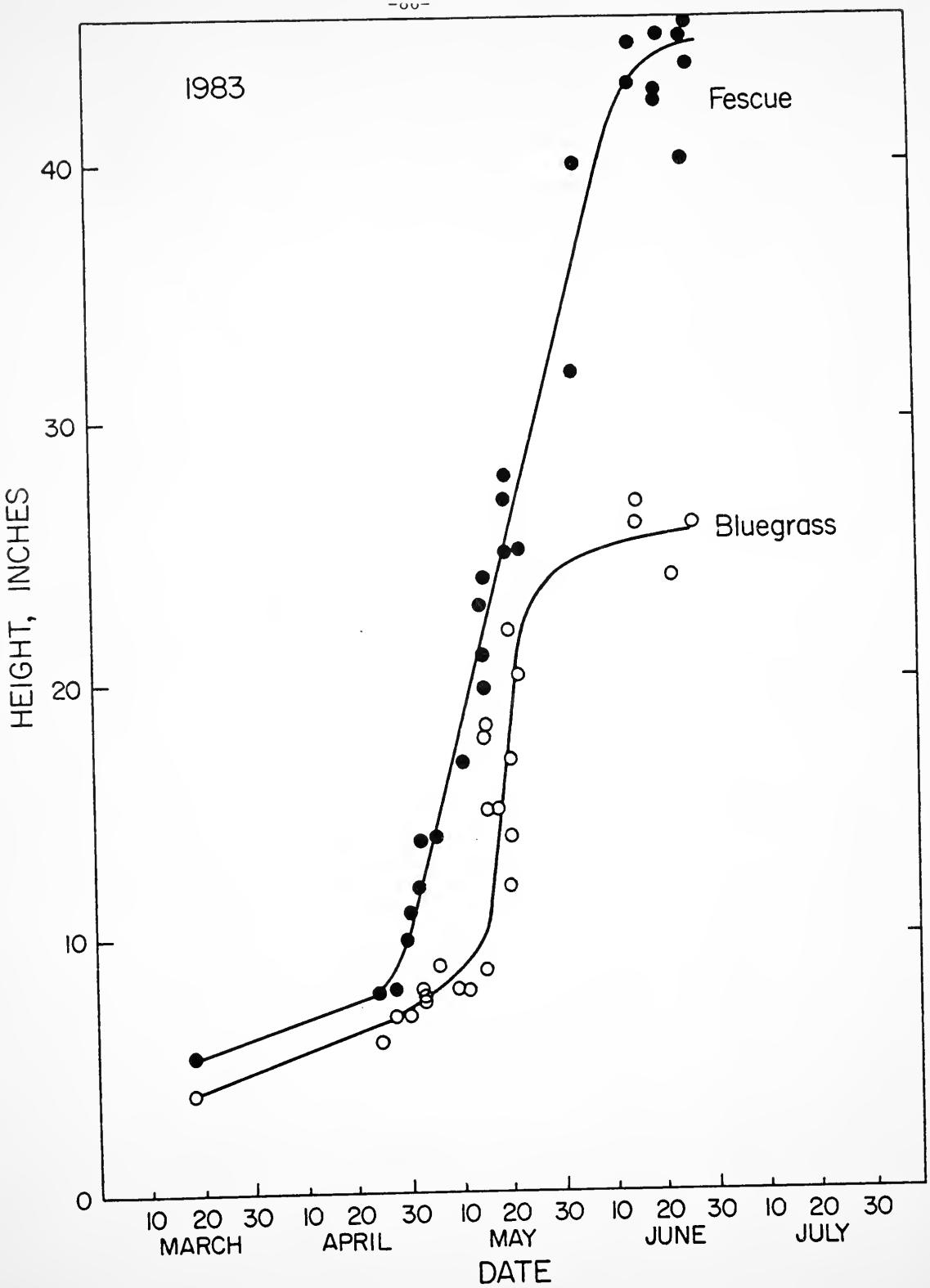
** Only about 6 inches high in treated plots compared to about 36 inches high in untreated plots

Ground Cherry, Bull Nettle, Field Bindweed and Canada Thistle#

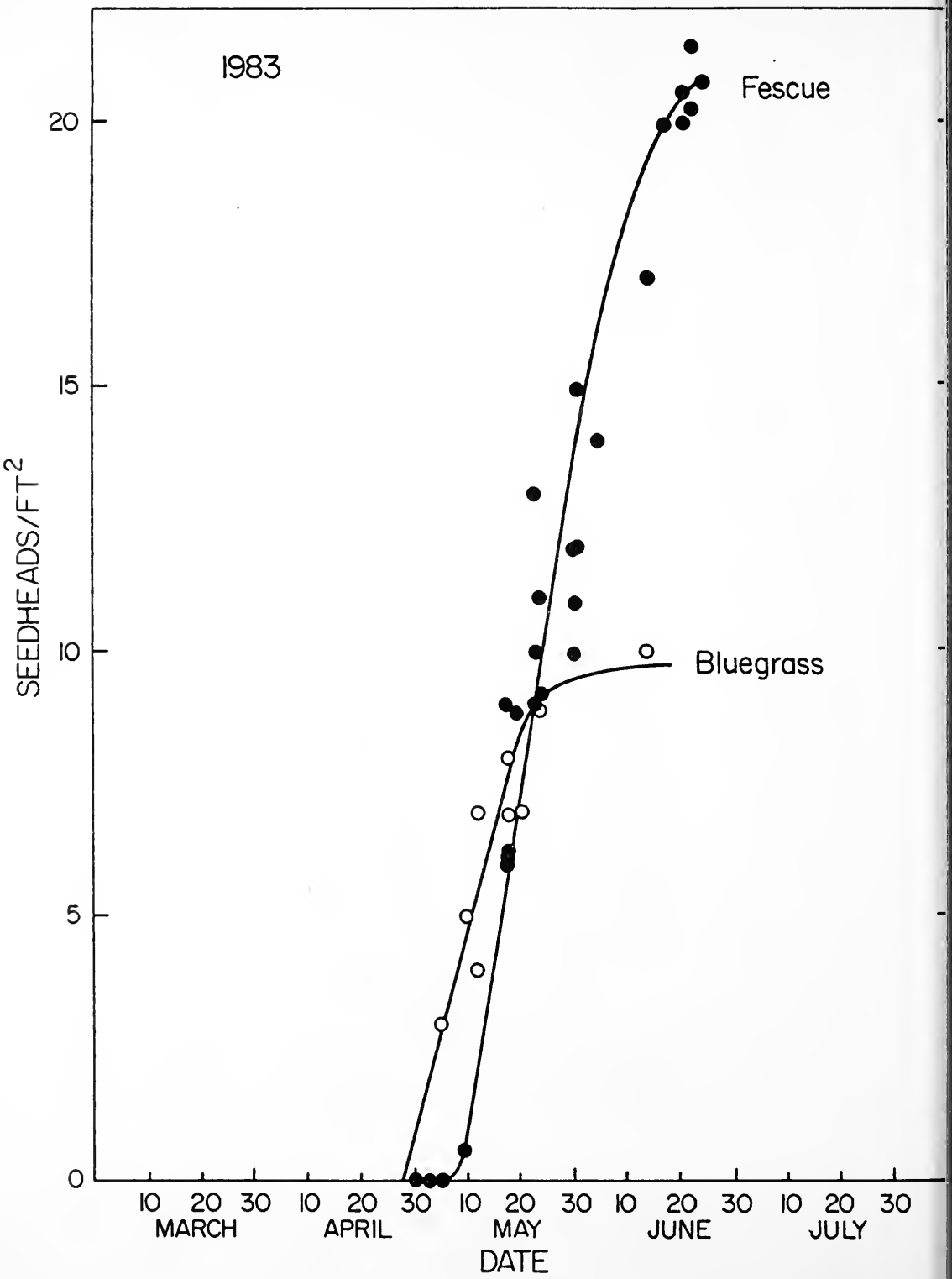
\# Thistle only about 6 inches high in treated plots compared to up to 36 inches high in untreated plots.

Species Not Controlled		Species Controlled	
Buckhorn Plantain	Climbing Milkweed	Dandelion	Dock
Common Plantain	Bull Nettle	Wild Carrot	Wild Parsnip
Whorled Milkweed	Ground Cherry	Clovers (Red, White, Sweet, Alsike)	
Common Milkweed	Field Bindweed	Black Medic	Chickory
			Most other Composites

95% control of wild carrot at 1/4 oz/A



Appendix Fig. 5. Growth of fescue (●) and bluegrass (0) during the 1983 season. IN-126 test area. Tippecanoe County, Indiana (West Lafayette).



Appendix Fig. 6. Seedhead formation in fescue (●) and bluegrass (0) during the 1983 season. IN-126 test area. West Lafyatte, Indiana (Tippecanoe County).

Table 50. Suggested program of chemical mowing to be implemented in 1984 in the spraying by contract program based on 1983 test results.

Materials: Embark (mefluidide) Plant Growth Regulator containing 2 lb active mefluidide per gallon. 2,4-D amine form concentrate containing 4 lb/gallon acid equivalent (Ester formulation of 2,4-D will not be used due to possible environmental hazards). X-77 or WK Surfactant concentrate. Glean concentrate.

Rate:

Schedule A: 1/2 lb/A Embark (mefluidide) + 0.5% X-77 (or WK) + 2 lb/A 2,4-D amine.

Material is mixed at the rate of approximately 2/3 gallon of Embark plus 1 gallon of X-77 (or WK) plus 1 1/4 gallons of 2,4-D amine in 100 gallons of water. The mixture is applied at the rate of 40 gallons per acre.

Note: This is the same recommendation as for 1983 and has proven satisfactory for dual lane highways and should be acceptable for the Interstate System.

Schedule B: 1/4 lb/A Embark (mefluidide) = 1 pint/A + 0.5% X-77 (or WK) + 1/4 oz /A Glean + 2 lb/A 2,4-D Amine

Material is mixed at the rate of approximately 1/3 gallon of Embark plus 1 gallon of X-77 (or WK) plus 5/8 oz Glean in 100 gallons of water (reduce to 1/2 oz of Glean for simplicity?). The mixture is applied at the rate of 40 gallons per acre.

Schedule C: 1/8 lb/A Embark (mefluidide) = 1/2 pint/A + 0.5% X-77 (or WK) + 1/8 oz/A Glean + 2 lb/A 2,4-D Amine

Material is mixed at the rate of approximatley 1/6 gallon of Embark plus 1 gallon of X-77 (or WK) plus 5/16 oz Glean in 100 gallons of water (reduce to 1/4 oz of Glean for simplicity?). The mixture is applied at the rate of 40 gallons per acre.

Schedule of Application: Recommended for application in the spring only. For schedules A and B, apply as the grass begins to green until just before the emergence of seedheads from the boot (end of March to the first week of May in Indiana). For schedule C, apply the last week of April and the first week of May.

COST OF MATERIAL COMPARISONS

Based on Glean $15/oz; Embark $55/lb; 2,4-D $2.25/lb; Surfactant $10.00/gal

	Material cost per acre				
Schedule	Embark	Surfactant	Glean	2,4-D Amine	Total
A	27.50	4.00	0	5.00	$36.50
B	13.75	4.00	3.75	5.00	26.50
C	6.90	4.00	1.90	5.00	17.80

BOTTOM LINE: The addition of Glean may permit a 50% reduction in cost of materials where schedule C can be followed.

A P P E N D I X II

1984

SUMMARY OF MAJOR FINDINGS

1984

SUMMARY OF MAJOR FINDINGS

Additional brief discussions of findings and summations are provided with the tables and figures.

1. Schedule B (1/4 lb Embark + 1/4 oz Telar + 2 lb 2,4-D Amine, all per acre, + 0.5% X-77 surfactant in the total spray mixture) and Schedule C (1/8 lb Embark + 1/8 oz Telar + 2 lb 2,4-D, all per acre, + 0.5% X-77 surfactant in the total spray mixture) were equivalent at most dates of application (Table 77, 81, 82, 83) including the very earliest data of application in 1984 on April 7. In these tests control of seedheads was greater than 90% and control of broadleaf weeds greater than 80%. Both Schedule B and Schedule C were superior to Schedule A (1/2 lb Embark + 2 lb 2,4-D amine, both per acre, + 0.5% X-77 surfactant in the total spray mixture)(Table 50).

2. Root length was not affected significantly by any of the schedules when evaluated in June, two months after application (Table 51). Similar results were obtained for annual bluegrass (Table 58).

3. Schedule B prevented growth of fescue and bluegrass for approximately one month following application (Fig. 7) but then vegetative growth resumbed. Seedheads were effectively controlled and final grass height of fescue were well within the mowing limits going into fall. A problem in some plots was growth of greasegrass or purpletop, a late developing prairie species (Table 52).

4. Melamine [3(NH_2)-triazine] was evaluated as an additive in combination with Embark and was found to be ineffective either alone or in combination with urea (Table 53, 55 and 63).

5. Evaluation of continuous Embark plots receiving materials annually since 1977 did not reveal serious signs of deterioration of turf compared to untreated control plots (Table 54).

6. DPX-T6376-2960 by DuPont was equivalent to Telar in either Schedule B or Schedule C but at approximately 1/2 the rate of material (Table 55, 65, 76, 81).

7. American Cyanamid ACP-1900 was ineffective as a single agent for control of seedheads in fescue at all applications rates tested up to 6 oz/A early (Table 56, 59, 69, 75) but was effective in combination with either Telar or Embark (Table 60, 74, 76, 78) or as a single agent late (Table 69, 70).

7. Experimental material Mon 4621 was also ineffective as a single agent for control of seedheads in fescue (Table 57, 75)

8. Schedule B was evaluated on I-70 east of IN 231 in a IDOH application using Swinglok equipment. Control of fescue seedheads was 90% (Table 61). Weed control was 90% comparing all species (Table 62).

9. Three surfactants (X-77, LE-700 and Activator 90) were compared. Both X-77 and Activator 90 were superior to LE-700 and no detergent in combination with Schedule B (Table 64).

10. Tordon (picloram) was tested as a replacement for 2,4-D amine in the standard mixture of Schedule B. Seedhead control in fescue was unaffected by the replacement but a severe antagonism between the retardant materials and the Tordon was noted with regard to weed control (Tables 66, 67, 68).

11. Dowco 356, 1 lb/A, in place of Telar in Schedule B gave good control of fescue seedheads (Table 66) and superior control of weeds other than thistle compared to schedule B (Table 67).

12. In second year repeat applications, Embark (1/4 to 2 lb/A), Telar (1/4 to 4 oz/A) and DPX 3376-2960 (DuPont) (1/16 to 4 oz/A) were applied to the same plots as in 1983. At the end of the 1984 season there was no evidence of overt phytotoxicity from any of the treatments (Table 71, 72, 73). Grass appeared healthy. Only with 2 lb/A Embark (as mefluidide) was there evidence of injury. Native bluegrass was no longer present in the plot but fescue appeared healthy (Table 71).

13. Wild garlic sprayed with a mixture of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D amine + 0.5% of the total spray mixture of X-77 on May 9 to May 20 were killed within one week of the application and no regrowth was evident by fall.

14. A number of pre-emergence materials were added to the standard mixture of Schedule B in a effort to increase the effectiveness of the mixture for use on secondary roads (Tables 79 and 80). Control of foxtail was best by 3 lb/A of Balan (Table 79, Fig. 8). Betesan was less effective even to rates of 20 lb/A.

15. Poast was the only treatment where the appearance of the plot was acceptible overall. Seedheads of smooth brome and orchard grass were reduced in number and short. Fescue seedheads were controlled completely. Canada thistle, while not killed, was shorter in the plot, spindly and less prone to form blossoms. Some control of foxtail was also achieved and that foxtail present was short. These findings are summarized in Table 80.

Table 51A. Comparison of Schedule A, Schedule B, Schedule C and modified Schedules B and C on seedhead and growth parameters of fescue and bluegrass. IN-126 test area. Applications were on April 7, 1984. Fescue was 5 inches tall. Bluegrass was 2.5 inches tall. 40 gpa. 40 psi. Evaluations were on April 23, April 29 (vegetative growth), May 4, May 12, May 18 (vegetative growth and seedheads), June 11 (seedheads and root development) and August 22 (seedheads, blade length and weed control). 3 ft X 6 ft plots in 3 replications.

	Amount					Fescue			Bluegrass			Total	
Schedule	Embark	X-77	Telar	DPX-T6376-2960	2,4-D amine	SH/ft^2*	SH Ht	Bld Ht	SH/ft^2*	SH Ht	Bld Ht	weeds/18 ft^2	% Cor
-	-	-	-	-	-	25±6	42±5	18±1	8±6	20±3	12±1	41±24	-
C	1/8 lb	0.5%	1/8 oz	-	2 lb	1.9±1.5	28±5	17±1	2±0.6	15±2	11±2	8±5	80
B	1/4 lb	0.5%	1/4 oz	-	2 lb	0.2±0.2	22±2	16±1	4±2	13±2	9±1	7±4	83
-	1/8 lb	0.5%	-	1/16 oz	2 lb	1.4±0.4	25±3	13±2	2±1	13±2	10±1	7±6	83
-	1/4 lb	0.5%	-	1/8 oz	2 lb	0.6±0.6	28±12	15±1	2±2	13±2	10±1	5±0	88
A	1/2 lb	0.5%	-	-	2 lb	0.4±0.2	25±2	15±1	0.4±0.2	12±3	10±1	22±8	46

SH = seedheads. Bld Ht = length of leaf blade (extended) in inches. Ht = height in inches. Amounts of materials are in rates per acre of active materials except for X-77 which is percent of the total spray mixture.

Control of seedheads was greater than 90% and control of broadleaf weeds greater than 80% for all treatments, except Schedule A were weed control was less than 50%.

*Total seedheads per plot were counted so that the first decimal is significant.

Weed species present included dandelion, red clover, plantain, wild carrot, white colver and common ragweed.

Table 51B. Comparison of Schedule A, Schedule B, Schedule C and modified Schedules B and C on root lengths of fescue and bluegrass. IN-126 test area. Applications were on April 7, 1984. Fescue was 5 inches tall. Bluegrass was 2.5 inches tall. 40 gpa. 40 psi. Evaluations were on June 11, 1984. 3 to 5 samplings averaged for each of 3 replicate plots ± standard deviation.

	Amount					Root length, cm	
Schedule	Embark	X-77	Telar	DPX-T6376-2960	2,4-D amine	Fescue	Bluegrass
-	-	-	-	-	-	5.8±0.4	5.6±0.6
C	1/8 lb	0.5%	1/8 oz	-	2 lb	5.0±0.9	5.7±0.4
B	1/4 lb	0.5%	1/4 oz	-	2 lb	6.5±0.8	5.9±0.7
-	1/8 lb	0.5%	-	1/16 oz	2 lb	6.2±0.9	5.5±0.9
-	1/4 lb	0.5%	-	1/8 oz	2 lb	5.3±0.9	5.9±1.9
A	1/2 lb	0.5%	-	-	2 lb	5.9±0.4	6.3±1.4

Amounts of materials are in rates per acre of active materials except for X-77 which is percent of the total spray mixture. Differences in root length were not statistically significant for any of the treatments.

Table 52. Growth of greasegrass or purpletop (Tridens flava), a native prairie species, comparing Schedule A, Schedule B, Schedule C and modified Schedules B and C. IN-126 test area. Applications were on April 7, 1984. 40 gpa. 40 psi. Evaluations were on August 22, 1984. 3 ft X 6 ft plots in 3 replications.

	Amount					Tridens flava	
Schedule	Embark	X-77	Telar	DPX-T6376-2960	2,4-D amine	Seedheads/ft^2	Seedhead Ht.
-	-	-	-	-	-	1.3±1.3	38±0
C	1/8 lb	0.5%	1/8 oz	-	2 lb	1.6±1.1	41±6
B	1/4 lb	0.5%	1/4 oz	-	2 lb	2.7±2.0	47±4
-	1/8 lb	0.5%	-	1/16 oz	2 lb	2.8±0.9	37±1
-	1/4 lb	0.5%	-	1/8 oz	2 lb	2.9±1.7	44±3
A	1/2 lb	0.5%	-	-	2 lb	1.0±1.3	31±6

Table 53. Evaluation of Embark plus Melamine as a potential additive for seedhead suppression in bluegrass and fescue. Applications on April 7, 1984. Evaluations on May 17, 1984. IN-126 Test Area. Plots mowed following evaluation.

Treatment Amount					Fesuce		Bluegrass	
Embark	X-77	Glean	2,4-D Amine	Melamine	SH/ft^2	SH Ht	SH/ft^2	SH Ht
-	-	-	-	-	22 ± 2	36	No bluegrass	
1/2 lb	0.5%	-	2 lb	-	1 ± 2	18	No bluegrass	
1/4 lb	0.5%	-	2 lb	-	6 ± 4	22	No bluegrass	
1/4 lb	0.5%	-	2 lb	10 lb	7 ± 3	20	No bluegrass	

Table 54. Evaluation of continuous Embark plots. Embark (1/2 lb/A, alone or in combination with 2,4-D or various additives has been applied annualy in the spring since 1977. Evaluations in 1984 were on April 7, just prior to the 1984 application of material for the 8th consecutive year. The turf, consisting of both bluegrass and fesuce showed the first possible signs of deterioration. Possibly as the result of an especially hot and dry summer bluegrass was reduced but fescue remained healthy and vigorous. IN-126 Test Area.

	Grass Height (Inches)	
Treatment	Bluegrass	Fescue
None	2.3 ± 0.3	5.0 ± 0.6
	1.8 ± 0.3	4.4 ± 0.4

Table. 55. Comparison of three additives (Telar, DPX-T6376-2960 and Melamine) in combination with Embark and 2,4-D amine for control of seedheads of fescue, bluegrass and smooth brome. Applications were on April 10, 1984 with evaluations on May 7, June 1 and August 27, 1984. Plots were 6 ft X 15 ft. IN -126 test area. Initial height of fescue 7.5 inches. Initial height of bluegrass 3 inches. Initial height of smooth brome 7.5 inches. Data reported were collected June 1, 1984.

Amount[a]						Fescue[b]		Bluegrass[b]		Smooth Brome[b]	
Embark	X-77	Telar	DPX	Melamine	2,4-D	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht
-	-	-	-	-	-	38 ± 1	34	19 ± 5	33	17 ± 4	41
1/8 lb	0.5%	1/8 oz	-	-	2 lb	12 ± 2	25	9 ± 1	20	16 ± 1	43
1/4 lb	0.5%	1/4 oz	-	-	2 lb	12 ± 1	25	9 ± 5	31	13 ± 1	41
1/8 lb	0.5%	-	1/16 oz	-	2 lb	12 ± 10	34	10 ± 8	32	13 ± 6	31
1/4 lb	0.5%	-	1/8 oz	-	2 lb	11 ± 1	39	9 ± 7	31	5 ± 3	36
1/4 lb	0.5%	-	-	-	2 lb	16 ± 2	33	5 ± 1	29	5 ± 1	33
1/4 lb	0.5%	-	-	10 lb	2 lb	18 ± 6	38	11 ± 8	32	5 ± 3	34
1/2 lb	0.5%	-	-	-	2 lb	10 ± 2	37	5 ± 1	29	5 ± 1	40

[a] Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
DPX = DPX-T6376-2960 (DuPont) = oz/A of active material
Telar = oz/A of active material
Melamine = lb/A of $3(NH_2)$-triazine
2,4-D amine = lb/A 2,4-D acid equivalent

SH/ft^2 = seedheads/ft^2 based on three measurements ± standard deviation

SH Ht = height of seedheads (maximum average)

[b] Similar observations were made at both the early and late evaluations. Embark + either the DPX or Telar additives gave about 70% control of seedheads in fescue and 50% control of seedheads in bluegrass compared to 60% (fescue) and 70% (bluegrass), respectively, for 1/4 lb/A Embark. The test area was very uneven especially with regard to the stand of bluegrass and smooth brome but at this date of application, none of the treatments could be regarded as effective based both upon the June and August 27 evaluations. Melamine, 10 lb/A, was apparently without effect on any of the test parameters in combination with 1/4 lb/A Embark.

Table 56. Varying rates of American Cyanamid ACP-1900 experimental grass growth regulator on seedhead formation in fescue, bluegrass and smooth brome. Treatments applied to triplicate 3 ft X 15 ft plots on April 13, 1984. Plots were rated visually on May 7 and June 1. Final seedhead data collected on August 28, 1984. IN 126 test area.

ACP-1900	Fescue		Bluegrass		Smooth Broome		Orchard Grass	
oz/A	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht
0	13 ± 1	37 ± 1	9 ± 3	25 ± 2	11 ± 1	39 ± 1	7	45
1/8	10 ± 2	36 ± 4	6 ± 3	26 ± 3	12 ± 0	40 ± 2		
1/4	9 ± 3	37 ± 2	8 ± 3	21 ± 2	12 ± 0	41 ± 3		
1/2	8 ± 2	31 ± 6	5 ± 1	26 ± 3	10 ± 3	38 ± 1	8	48
1	5 ± 1	30 ± 1	5 ± 1	17 ± 2	9 ± 3	35 ± 5		

The final seed head data were verified from the early ratings. Activity was seen at 1/4 oz/A early but did not hold with the early application. There was definite activity at the 1/2 and 1 oz/A rates. No grass toxicity was observed at any time.

Table 57. Effect of application rate of experimental material Mon 4621 alone on seedhead formation and seedhead height of fescue, smooth brome and bluegrass. Applied April 13, 1984. Evaluations were on May 7 and August 27. Triplicate 3 ft X 15 ft plots. IN-126 Test Area.

Rate of Mon 4621 lb/A	Fescue		Bluegrass		Smooth Brome	
	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht
0	9 ± 1	41 ± 6	9 ± 1	26 ± 3	10 ± 2	41 ± 4
1	8 ± 1	35 ± 5	8 ± 1	24 ± 3	10 ± 3	41 ± 5
1.25	8 ± 1	37 ± 5	8 ± 1	25 ± 3	10 ± 2	41 ± 4
2	12 ± 3	42 ± 3	6 ± 3	23 ± 3	12 ± 3	37 ± 4
2.5	12 ± 3	36 ± 2	6 ± 3	23 ± 3	12 ± 0	38 ± 0
3	10 ± 2	40 ± 3	10 ± 2	24 ± 3	12 ± 0	35 ± 4
4	9 ± 3	38 ± 2	11 ± 1	28 ± 3	11 ± 1	45 ± 1
5	8 ± 2	39 ± 1	11 ± 1	26 ± 0	9 ± 1	40 ± 4
6	7 ± 1	39 ± 1	8 ± 1	26 ± 1	9 ± 2	39 ± 3
8	6 ± 0	40 ± 2	6 ± 0	27 ± 1	10 ± 2	39 ± 2

Note: Some slight retardation was noted from the higher rates but with this early application, no differences could be discerned in the final evaluations reported.

Table 58. Embark and Embark + Telar on growth and seedhead formation of annual bluegrass (*Poa annua*) and effect on root development. Applications were on April 13, 1984. Final data were collected on May 5, 1984. Unmowed test area located on the Purdue University Campus in lawn adjacent to Smith Hall.

Amount			Seedheads		Length[a]		
Embark	X-77	Telar	No per ft^2	Height[a]	Blade	Root	Root/Shoot Ratio[b]
-	-	-	312	5.4±0.8	3.5±0.7	3.9±0.6	1.11
1/4 lb	0.25%	1/4 oz	37	2.8±0.3	2.4±0.7	3.4±1.5	1.42
1/2 lb	0.25%	-	236	3.9±0.9	2.4±0.3	3.6±0.4	1.5

[a] In centimeters.

[b] Root length divided by blade (shoot length).

Root growth was inhibited by no more than 8% by 1/2 lb/A of Embark alone or 12% by the combination of Embark 1/4 lb/A + Telar 1/4 oz/A. The root/shoot ratios were improved by both materials.

Amounts are in lb/A mefluidide (Embark), oz/A chlorsulfuron (Telar) and percent (by volume) of the total spray mixture of X-77 surfactant.

Table 59. Varying rates of Monsanto Mon 4621 experimental grass growth regulator on seedhead formation in fescue, bluegrass, smooth brome and orchardgrass. Treatments applied to triplicated 3 ft by 15 ft plots on April 16. Weather was cold and wet at the time of application. Rained three days prior to application. Sprayed in a light drizzle. Plots were rated visually on May 7 and June 1. Final seedhead data collected August 28, 1984. IN 126 test area.

Mon-1900	Fescue		Bluegrass		Smooth brome		Orchard Grass	
lb/A	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht
0	12 ± 0	37 ± 1	12 ± 0	21 ± 2	12 ± 2	46 ± 4	8	44
1	11 ± 2	37 ± 2	7 ± 1	21 ± 4	12 ± 2	44 ± 3	-	-
1.25	11 ± 1	35 ± 3	8 ± 2	21 ± 1	12 ± 2	38 ± 6	-	-
2	12 ± 3	36 ± 1	7 ± 1	21 ± 3	10 ± 3	38 ± 6	-	-
2.5	10 ± 2	38 ± 2	4 ± 0	20 ± 3	12 ± 0	38 ± 0	-	-
3	9 ± 1	35 ± 0	6 ± 2	20 ± 2	10 ± 3	38 ± 2	-	-
4	7 ± 1	30 ± 6	4 ± 4	18 ± 3	9 ± 1	35 ± 3	1	22
5	5 ± 4	29 ± 8	6 ± 4	21 ± 3	9 ± 3	39 ± 5	4	23
6	5 ± 3	22 ± 3	1 ± 1	16 ± 2	6 ± 1	37 ± 2	-	-
8	3 ± 2	24 ± 2	3 ± 2	17 ± 1	5 ± 3	31 ± 5	2 ± 2	28 ± 2

This test was a repeat of the test applied April 13 with similar results. Activity was observed at application rates of 3 lb/A or higher. Maximum seed head suppression was about 60% for fescue, 75% for bluegrass, 50% for smooth brome and 50-75% for orchard grass. For the latter, only a few plots contained isolated clumps but seedhead suppression was obvious. As a single agent, this material does not appear useful for roadside use in a mid-April application.

Table 36. Summary of varying rates of Embark, Glean and DPX-T-6376-2960 in combination with X-77 Surfactant and 2,4-D on fescue. IN-126 test area. Applied May 12 and 13, 1982. Rained about 2 hours after the materials were applied both days. Evaluations on June 27, 1983. 3' X 7.5' plots in triplicate. Initial height of fescue 16 ± 1 inches. Essentially no bluegrass present. From Table 35.

Amount*					Fescue	
Embark	X-77	Glean	DPX	2,4-D	Seed Heads/ft^2	Seed Head Height**
-	-	-	-	-	15 ± 1	35 ± 1
1/16 lb	0.5%	all treatments		2 lb	13 ± 1	34 ± 1
1/8 lb	0.5%	all treatments		2 lb	9 ± 1	26 ± 3
1/4 lb	0.5%	all treatments		2 lb	7 ± 3	26 ± 4
all rates	0.5%	1/8 oz	-	2 lb	10 ± 4	28 ± 4
all rates	0.5%	1/4 oz	-	2 lb	9 ± 4	27 ± 5
all rates	0.5%	1/2 oz	-	2 lb	9 ± 4	27 ± 6
all rates	0.5%	-	1/16 oz	2 lb	11 ± 1	32 ± 3
all rates	0.5%	-	1/8 oz	2 lb	9 ± 3	31 ± 4
all rates	0.5%	-	1/4 oz	2 lb	9 ± 4	27 ± 5

* Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
Glean and DPX-T6376-2960 = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

** Height in inches

Reduction of seed head per ft^2 proportional to rate of Embark but except for 1/16 oz/A of DPX was independent of Glean or DPX amount (1/16 oz/A = 1/8 oz/A = 1/4 oz/A of Glean and 1/8 oz/A = 1/4 oz/A of DPX). Glean and DPX gave equivalent results.

Note: Rained 2 hours after treatments were applied so that effectiveness was reduced compared to other tests where rain was delayed for longer periods.

Table 37. Weed control from varying rates of Glean and DPX in the presence of 1/4 lb/A Embark as mefluidide and 0.5% X-77 plus 2 lb/A 2,4-D amine. IN-126 test area. Applied May 12, 1983. Rained about 2 hours after the materials were applied. Evaluations on July 5, 1983. 3' X 7.5' plots in triplicate. Results are averages ± standard deviations.

		Amount*			Weeds per 20 ft^2			
Embark	X-77	Glean	DPX	2,4-D	Carrot	Dandelion	Thistle + Milkweed	Total
-	-	-	-	-	3 ± 2	2 ± 2	1 ± 2	6 ± 2
1/4 lb	0.5%	1/8 oz	-	2 lb	3 ± 5	0 ± 0	1 ± 2	4 ± 6
1/4 lb	0.5%	1/4 oz	-	2 lb	1 ± 1	1 ± 2	0 ± 1	2 ± 1
1/4 lb	0.5%	1/2 oz	-	2 lb	0 + 0	0 ± 0	1 ± 2	1 + 2
1/4 lb	0.5%	-	1/16 oz	2 lb	1 ± 0	1 ± 1	0 ± 1	2 ± 0
1/4 lb	0.5%	-	1/8 oz	2 lb	1 ± 1	0 ± 0	1 ± 1	2 ± 1
1/4 lb	0.5%	-	1/4 oz	2 lb	3 ± 5	0 ± 0	0 ± 1	3 ± 5

* Embark = lb/A as mefluidide
X-77 = % by volume in total spray mixture
Glean and DPX-T6376-2960 (DPX) = oz/A of active material
2,4-D = lb/A of acid equivalent of the dimethylamine salt

Despite the rain following treatment, the combinations containing 1/4 or 1/2 oz/A of Glean gave reasonable control of wild carrot. Overall, the treated plots averaged 2.3 ± 1.0 weeds/20 ft^2 or 62% compared to control.

Table 60. Substitution of Mon 6421 or ACP 1900 for Embark or Telar in the basic mixture with 0.5% X-77 surfactant and 2 lb/A 2,4-D amine. Treatments applied April 18, 1984. 18 ft^2 plots with 3 replications. Weather was overcast and cool but dry. Initial fescue height 8 inches. Initial bluegrass height 5 inches. Evaluations were on May 5, May 9, June 10 and September 9, 1984. In the following table, seedhead information is from June 10 and September 9 (equivalent results) and weed control information is from September 9. IN-126 test area.

Amount							Fescue		Bluegrass		Smooth brome*		Grass Height May 9		Weeds
Embark	X-77	Telar	DPX	2,4-DA	Mon6421	ACP1900	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	Fescue	Bluegrass	per 18 ft^2
-	-	-	-	-	-	-	20±4	45±6	25±6	24±4	10	40	14±1	10±1	9±5
1/8 lb	0.5%	1/8 oz	-	2 lb	-	-	3±2	29±3	12±2	22±3	10	33	7±2	7±2	3±2
1/4 lb	0.5%	1/4 oz	-	2 lb	-	-	1±1	22±5	20±5	18±2	8	38	6±1	4±1	4±4
1/8 lb	0.5%	-	1/16 oz	2 lb	-	-	3±1	28±2	12±7	18±2	10 (5)	40 (33)	7±2	5±1	1±1
1/4 lb	0.5%	-	1/8 oz	2 lb	-	-	2±2	22±12	10±4	18±2	10	40	6±1	6±2	2±1
1/2 lb	0.5%	-	-	2 lb	-	-	2±1	21±6	4±3	13±4	6	37	7±1	7±1	1±1
1/4 lb	0.5%	-	-	2 lb	1/2 lb	-	2±1	23±13	6±5	16±1	8	38	9±1	6±1	1±2
-	0.5%	-	-	2 lb	1 lb	-	4±1	31±4	13±3	18±1	10	40	8±1	6±2	2±1
-	0.5%	1/4 oz	-	2 lb	1/2 lb	-	2±1	25±2	18±14	25±4	10 (6)	48 (38)	7±1	6±1	3±4
1/4 lb	0.5%	-	-	2 lb	-	1/8 oz	2±1	29±3	10±1	17±4	10	49	7±1	5±1	3±3
-	0.5%	-	-	2 lb	-	1/4 oz	5±4	39±1	21±14	25±4	12	38	7±2	6±1	2±1
-	0.5%	1/4 oz	-	2 lb	-	1/8 oz	4±2	29±3	13±8	25±2	10 (12)	48 (38)	6±1	6±1	3±1

* Numbers in parenthesis are for orchard grass.

Visually, the plots with ACP 1900 looked very good until mid-June when seedheads began to appear. Most seedheads on these plots were late seed heads. Except for Mon 6421 and ACP 1900 alone and ACP 1900 + Telar, control of seedheads in fescue was about 90%. Weed control, overall, was 75%.

SH = seedheads. SH Ht = height of seedheads in inches. DPX = DPX-T6376-2960.

Table 61. Evaluation of a spring application of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D Amine + 0.25% (by volume of total spray mixture) (25 gpa/Swinglok), Indiana Department of Highways, on I-70 east of IN 231 (Alternative B). Application was on April 18, 1984. Evaluations were on August 24, 1984, 4 months after application.

	Fescue[a]			Bluegrass[a]		
	Seedheads			Seedheads		
	per ft^2	height	Blade height	per ft^2	height	Blade height
Median:						
Unsprayed	17 ± 1	39 ± 2	15 ± 4	12 ± 4	21 ± 1	13 ± 2
Sprayed	2 ± 3	20 ± 5	14 ± 3	2 ± 1	13 ± 3	10 ± 2
Control	90%			83%		
Pavement to Ditch:						
Unsprayed	15 ± 3	37 ± 2	18 ± 3	7 ± 2	21 ± 1	14 ± 2
Sprayed	1.6±1.1	24 ± 2	14 ± 2	0.7±0.6	14 ± 2	11 ± 1
Control	90%			90%		

[a] Based on measurements from 4 different locations selected at random. Heights are average maximum heights from 10-20 plants per location ± standard deviation among different locations. Rates are of active ingredient. Initial height of bluegrass 3.5-4 inches. Initial height of fescue 6-7 inches.

Table 62. Control of weeds by a spring application of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D Amine + 0.25% (by volume of total spray mixture)(25 gpa Swinglok Sprayer), Indiana Department of Highways, on I-70 east of IN 231 (Alternative B). Applied Apil 18, 1984. Evaluations on August 24, 1984.

	Weeds/1000 ft^2											
	Rag-weed	White top	Wild carrot	Lespe-deza	Common spurge	Milk weed	Wild lettuce	Clover Sweet	Clover Red	Black medic	Aster	Total[a]
Median:												
Unsprayed	43	67	0	204	30	18	0	27	0	0	2	391
Sprayed	11	0	0	12	0	1	0	0	5	1	0	30
Control												92%
Pavement to Ditch:												
Unsprayed	63	9	0	182	54	87[b]	4	57	0	0	12	468
Sprayed	21	0	2	18	11	0	1	3	0	6	0	62
Control												87%

[a] Sum of all weeds counted in 3 different locations. The area was not especially weedy averaging 18,600 weeds per acre. The treatment reduced the weed population to about 2,000 weeds per acre equivalent to 90% control of all species.

[b] Includes 85 whorled milkweed.

Table 63. Effect of Melamine [3(NH_2)-triazine] and urea, alone and in combination with two rates of Embark of growth and seedhead parameters of bluegrass and fescue under roadside conditions. IN-126 test area. Applications were on April 21, 1984. Weather was cold but dry. The high rate of Melamine did not completely dissolve. Plots were 3ft X 6ft and in triplicate. Evaluations were on May 10, June 11 and September 10, 1984. Initial height of fescue was 7 inches. Initial height of bluegrass was 4 inches. In the following table, seedhead information is from June 10 for bluegrass and from June 11 and September 10 for fescue (equivalent results). Weed control information and final blade heights are from September 10.

Amount*				Fescue			Bluegrass			Grass Height May 10		Weeds
Embark	X-77	Melamine	Urea	SH/ft^2	SH ht	Bld Ht	SH/ft^2	SH ht	Bld Ht	Fescue	Bluegrass	per 18 ft^2
-	-	-	-	20±1	37±5	22±1	13±6	22±2	17±1	11±1	9±1	7 ± 3
-	-	-	40 lb	25±2	39±3	19±2	10±7	23±2	16±1	10±1	9±2	7 ± 3
-	-	16.7 lb	23 lb	25±2	38±3	24±2	8±2	21±3	16±2	11±0	9±2	8 ± 3
-	-	0.8 lb	-	20±6	38±3	22±1	11±4	23±4	16±1	11±2	8±1	13 ± 3
1/4 lb	0.5%	-	40 lb	6±2	27±3	18±4	1±1	13±3	14±1	7±0	7±2	9 ± 5
1/2 lb	0.5%	-	40 lb	3±0	26±4	23±5	1±1	17±3	16±1	9±2	8±1	10 ± 3
1/4 lb	0.5%	16.7 lb	23 lb	6±2	28±3	18±2	1±1	17±5	14±0	8±2	4±1	9 ± 5
1/2 lb	0.5%	16.7 lb	23 lb	2±1	25±6	16±1	1±1	18±9	16±1	7±1	4±1	9 ± 3
1/4 lb	0.5%	0.8 lb	-	8±3	32±6	18±2	3±2	17±6	14±2	10±0	6±1	10 ± 7
1/2 lb	0.5%	0.8 lb	-	6±2	31±6	19±3	1±1	18±3	15±2	8±1	6±2	14 ± 4
1/4 lb	0.5%	-	-	7±3	31±6	19±4	2±3	18±5	13±2	9±2	7±1	13 ± 4
1/2 lb	0.5%	-	-	5±3	28±4	21±1	1±1	13±2	16±2	7±2	8±1	15 ± 3

*Amounts are in pounds per acre of Embark (as mefluidide), 3(NH_2)-triazine and urea and percent of total spray mixture for X-77. SH = seedheads; SH ht = height of seedheads in inches; Bld Ht = extended length of leaf blades in inches.

Applications were at 40 gpa and 40 psi.

At the 1/2 lb/A rate of Embark, the treatments containing urea (40 lb/A) or melamine + urea (16.7 lb/A + 23 lb/A), each calculated to yield the same amount of nitrogen per acre, were slightly superior to Embark alone in terms of seehead suppression. However, at the 1/4 lb/A rate of Embark, there was no significant improvement except for urea (40 lb/A) on bluegrass only and on early growth of fescue. The low rate of melamine alone (0.8 lb/A) was not beneficial.

Table 64. Comparison of three surfactants in combination with Embark, DPX-T6376-2960 (DuPont), Telar and 2,4-D amine on growth and seedhead parameters of bluegrass and fesuce under roadside conditions. IN-126 test area. Applications were on April 25, 1984. Weather was clear and warm. Soil was wet. Plots were 3 ft X 6 ft in triplicate. Evaluations were on May 14, June 11 and September 11, 1984. Initial height of fescue was 8 inches. Initial height of bluegrass was 4.5 inches. In the following table, data for seedheads are from June 11 with equivalent results observed on September 11. Final blade heights and weed control information are from September 11.

Amount							Fescue			Bluegrass			Grass Height May 14		Weeds
		Activator													
Embark	X-77	LE-700	90	Telar	DPX	2,4-D amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	Fescue	Bluegrass	per 18 ft^2
-	-	-	-	-	-	-	24.0±1.0	37±3	27±4	7.0±1.0	21±1	19±3	13±2	10±1	11±3
1/8 lb	0.5%	-	-	1/8 oz	-	2 lb	1.1±0.6	19±3	19±3	2.5±2.2	15±5	13±4	8±2	7±1	1±1
1/4 lb	0.5%	-	-	1/4 oz	-	2 lb	1.7±0.9	17±3	18±3	1.5±1.4	11±4	12±1	7±1	7±1	1±2
1/4 lb	-	0.25%	-	1/4 oz	-	2 lb	3.4±4.2	25±6	18±1	2.7±2.8	16±3	14±1	8±2	6±1	1±1
1/4 lb	-	-	0.25%	1/4 oz	-	2 lb	0.8±0.5	21±8	20±5	1.2±0.2	14±8	15±1	8±2	6±1	3±2
1/4 lb	-	-	-	1/4 oz	-	2 lb	1.7±1.2	21±1	20±2	3.6±3.1	16±1	15±2	9±1	7±2	1±2
1/4 lb	0.25%	-	-	1/4 oz	-	2 lb	0.8±0.5	22±2	18±3	2.2±2.2	17±3	13±1	7±1	6±0	4±4
1/8 lb	0.5%	-	-	-	1/16 oz	2 lb	1.9±1.0	20±6	19±1	0.8±0.2	15±3	14±2	8±1	7±1	2±3
1/4 lb	0.5%	-	-	-	1/8 oz	2 lb	0.9±1.0	17±5	17±2	1.8±1.6	15±5	15±3	8±1	7±1	3±2
1/2 lb	0.5%	-	-	-	-	2 lb	2.7±2.3	23±8	21±3	0.1±0.2	10±1	15±3	9±1	7±1	1±1

Amounts are in pounds per acre of Embark (as mefluidide), oz/A of active ingredient of Telar and DPX (=DPX-T6376-2960 Dupont) and lb/A of 2,4-D acid equivalent for 2,4-D amine. Amounts of X-77, LE-700 and Activator 90 are in percent of total spray mixture. Applications were at 40 gpa and 40 psi.

SH=seedheads; SH ht = height of seedheads in inches; Bld ht = extended length of leaf blade in inches. Seedheads were counted in the total plot so that data are expressed to the first decimal.

There were no significant differences among any of the treatments from the evaluation on May 14. Phytotoxicity (yellow discoloration) was evident for the first four treatments (not counting the control) and for the last treatment.

For the June 11 evaluation, X-77 and Activator 90 were equivalent but superior to LE-700 or no detergent. No significant differences among the three detergents could be discerned from the September 11 evaluation.

Schedule B (1/4 lb Embark + 1/4 oz Telar) gave 97% control of fescue seedheads compared to 90% for schedule A (1/2 lb Embark). Overall weed control was 82%. Schedule A was superior to Schedule B for control of bluegrass seedheads.

Table 65. Effect of varying rates of DPX-T6376-2960 (DPX) in combination with 2 rates of mefluidide (Embark) on growth and seedhead parameters of bluegrass and fescue. IN-126 test area. Applications were on May 2, 1984. Plots were 3 ft X 6 ft in triplicate. Evaluations were on June 12 and September 12, 1984. Initial height of fescue was 11 inches. Initial height of bluegrass was 7 inches. In the table, seedhead data are from June 12 (with consistent results on September 12) and final blade height and weed data are from September 12.

Amount*					Fescue			Bluegrass			Weeds**
Embark	X-77	Telar	DPX	2,4-D amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	per 18 ft^2
-	-	-	-	-	23±4	45±7	31±4	6±1	28±6	24±5	6±3
1/8 lb	0.5%	1/8 oz	-	2 lb	2±2	28±8	24±5	10±8	24±5	18±5	2±2
1/8 lb	0.5%	-	1/16 oz	2 lb	6±3	29±7	22±4	9±2	25±3	18±3	1±1
1/8 lb	0.5%	-	3/32 oz	2 lb	5±1	26±6	21±3	10±5	24±4	18±1	2±2
1/8 lb	0.5%	-	1/8 oz	2 lb	4±4	22±8	23±3	12±12	18±6	16±2	1±2
1/4 lb	0.5%	1/4 oz	-	2 lb	1±1	20±5	19±3	7±7	20±6	18±6	0±1
1/4 lb	0.5%	-	1/8 oz	2 lb	1±1	19±1	23±2	13±12	20±7	16±2	3±3
1/4 lb	0.5%	-	3/32 oz	2 lb	2±2	18±3	19±3	11±6	20±4	17±3	2±1
1/4 lb	0.5%	-	1/4 oz	2 lb	8±5	21±2	19±7	12±3	22±8	18±4	4±1
1/2 lb	0.5%	-	-	2 lb	11±4	32±9	20±3	12±9	22±8	16±2	1±2

* Amounts are active ingredient. X-77 amount are as % of the total spray mixture. Applications were at 40 gpa and 40 psi.

SH=seedheads; SH ht = height of seedheads in inches; Bld ht = extended length of blade in inches.

**Mostly 2,4-D resistant species such as ironweed, milkweed, ground cherry, bindweed bullnettle, spurge and three-seeded mercury. Overall weed control was 72%.

In the mixture with 1/4 lb/A Embark (as mefluidide), 1/8 oz of DPX-T6376-2960 was equivalent to 1/4 oz/A of Telar. Increasing the amount of DPX-T6376-2960 to 3/32 oz/A or 1/4 oz/A rendered the mixture less effective. With 1/8 lb/A of Embark (as mefluidide), 1/16 oz/A of DPX-T6376-2960 was as effective as 3/32 or 1/8 oz/A and statistically no different from 1/8 oz/A of Telar.

Table 66. Varying rates of Tordon (Picloram) as a replacement for 2,4-D amine in the standard mixture of Embark (1/4 lb/A) + Telar (1/4 lb/A) + 0.5% X-77 Surfactant. Applied April 26, 1984 to 6 ft X 12 ft plots (4 replications) located between the fence and ditch on US 52 north of West Lafayette, In near the Purdue University Agronomy Farm (south edge). Applications were by A. B. Hall, Dow, Cincinatti, using a CO_2 backpack sprayer fitted with a 60 inch boom and T-jet 11004 nozzles (40 gpa/ 80 psi). Final evaluations were on August 23, 1984.

SH = seedheads; Ht = height; all grass heights are in inches; SH/ft^2 = number of SH/ft^2; ± = S.D.= standard deviation; Bld Ht = extended blade length.

	Grass Species										Overall
	Fescue			Bluegrass			Orchardgrass		Timothy		Visual Grass
Treatment (all were with 0.5% X-77)*	SH/ft^2	SH Ht	Bld Ht	SH/ft^2**	SH Ht	Bld Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	Height
None (Control)	30±3	44±2	24±3	17±17	31±2	21±2	16±1	46±2	12	36	44
Standard Mixture (no 2,4-D) (1/4 lb/A Embark + 1/4 oz/A Telar)	5±1	24±8	21±2	8±7	24±4	18±4	4±3	32±9	-	-	22
Standard Mixture + 2 lb/A 2,4-D (1/4 lb/A Embark + 1/4 oz/A Telar)	3±3	19±2	20±3	12±4	20±2	14±3	6±2	28±6	12	33	18
Standard Mixture:											
+ Tordon 1/2 lb/A	4±3	22±1	20±2	8±5	24±3	16±2	4±3	34±2	8	29	21
+ Tordon 1/4 lb/A	6±4	26±6	20±2	10±8	26±2	16±3	7±3	31±6	12	40	22
+ Tordon 3/8 lb/A + 2,4-D 1/8 lb/A	3±3	24±1	19±2	6±4	25±5	16±2	5±1	29±8	-	-	21
+ Tordon 3/16 lb/A + 2,4-D 1/16 lb/A	4±3	28±5	23±4	6±5	28±7	16±3	6±5	30±6	6	32	24
2,4-D alone 2 lb/A	20±8***	40±8	25±3	22±16	35±3	20±4	16±3	41±4	13±1	40±5	40
Tordon alone 1/2 lb/A	28±6	46±1	28±4	21±16	33±4	20±5	18±7	41±4	13±2	41±5	46
1/4 lb/A	22±18	45±2	25±2	24±11	34±2	20±4	14±0	48±1	8±3	39±2	45
Tordon 3/8 lb/A + 2,4-D 1/8 lb/A	25±2	45±1	26±4	21±3	35±3	20±3	15±5	43±6	8±4	43±2	45
Tordon 3/16 lb/A + 2,4-D 1/16 lb/A	23±2	44±2	26±1	22±8	35±4	22±4	13±1	45±2	8	44	44
Embark alone 1/2 lb/A	2±2	28±7	24±4	2±2	22±3	18±4	12±0	34±6	8	36	23
Embark 1/2 lb/A + Tordon 1 lb/A	5±3	34±3	21±4	2±2	24±1	19±3	5±1	22±9	7±5	30±2	25
Tordon alone 1 lb/A	31±3	41±4	26±2	18±2	27±6	21±4	12±0	35±2	9±6	35±3	41
Embark 1/4 lb/A + 2,4-D 2 lb/A + DOWCO 356 1 lb/A	4±4	29±6	17±5	14±7	24±5	19±2	12±4	36±4	6	31	20

* 0.5% X-77 (by volume of total spray mixture). Other rates given in lb/A active ingredient.

**Plots were rated on May 17, June 19 and August 23 with consistent observations. Bluegrass seedhead data are from June 19 since most had shattered by August 23.

***Seed head number was visibly reduced by this treatment suggesting some cross-contamination with an Embark-containing material. 2,4-D alone normally does not affect fescue seedheads.

Table 67. Varying rates of Tordon (Picloram) as a replacement for 2,4-D amine in the standard mixture of Embark (1/4 lb/A) + Telar (1/4 lb/A) + 0.5% X-77 Surfactant comparing Canada Thistle and other weeds. Application April 26, 1984 to 6 ft X 12 ft plots (4 replications) located between the fence and ditch on US 52 north of West Lafayette, IN adjacent to Purdue University Agronomy Farm (south edge). Applied by A. B. Hall, Dow, Cincinatti, using a CO_2 backpack sprayer fitted with 60 inch boom and T-jet nozzles (40 gpa/80 psi). Evaluations were on August 23, 1984.

	Weeds/72 ft^2 ± Standard Deviation										
Treatment (all with 0.5% X-77 by vol)	Canadian thistle	Ground cherry	Wild carrot	Plan-tain	Dande-lion	Milk weed	Aster	Spurge	Annual* weeds	Total weeds	Total Weeds other than thistle
None (Control)	29±27	0	5±4	27±18	6±5	3±3	2±2	1±1	0	73 ± 53	44 ± 30
Standard Mixture (no 2,4-D) (1/4 lb/A Embark + 1/4 oz/A Telar)	56±55	0	0.5	32±24	10±8	0.5	3±5	2±2	1±2	105 ± 76	49 ± 23
Standard Mixture + 2 lb/A 2,4-D (1/4 lb/A Embark + 1/4 oz/A Telar)	56±40	0	1±2	8±10	3±3	1±1	2±4	4±5	1±1	76 ± 46	20 ± 9
Standard Mixture:											
+ Tordon 1/2 lb/A	72±38	5±10	1±2	21±11	8±10	0.5	1±1	2±4	0.5	111 ± 34	39 ± 20
+ Tordon 1/4 lb/A	100±74	0	0	16±5	10±7	5±4	2±4	2±3	1±1	136 ± 87	35 ± 16
+ Tordon 3/8 lb/A + 2,4-D 1/8 lb/A	101±54	0	0	17±7	13±9	1±2	0	3±3	0	135 ± 35	34 ± 12
+ Tordon 3/16 lb/A + 2,4-D 1/16 lb/A	87±63	0.5	0	26±17	8±10	1±0	0	0	0	122 ± 39	35 ± 25
2,4-D alone 2 lb/A	57±50	0	1±2	0	0.25	1±1	0	1±2	0	60 ± 51	3 ± 2
Tordon alone 1/2 lb/A	31±47	0	1±1	0	0	0	0	0	0	32 ± 46	1 ± 1
1/4 lb/A	20±27	0	0.5	0	0	0.5	0	0	0	21 ± 26	1 ± 2
Tordon 3/8 lb/A + 2,4-D 1/8 lb/A	53±56	0	1±1	0	0	1±2	0	0	0	55 ± 55	2 ± 2
Tordon 3/16 lb/A + 2,4-D 1/16 lb/A	32±30	0	0.5	1±1	0	2±1	0	0.5	0	36 ± 28	4 ± 3
Embark alone 1/2 lb/A	56±47	0	3±3	20±9	12±14	0.25	1±3	1±3	0	93 ± 41	37 ± 27
Embark 1/2 lb/A + Tordon 1 lb/A	20±28	0	0	2±3	0	0.25	0	3±5	0	25 ± 24	5 ± 5
Tordon alone 1 lb/A	6±6	0	0	0.25	0	1.5±1	0	4±8	0	12 ± 6	6 ± 7
Embark 1/4 lb/A + 2,4-D 2 lb/A + DOWCO 356 1 lb/A	71±37	0	1±2	1±2	0	1±1	0.5	1±2	0	76 ± 41	5 ± 5

* Included lambsquarter, pigweed and common ragweed.

Other than X-77 surfactant, rates are given in lb/A active material.

Table 68. Summary of varying rates of Tordon (Picloram) as a replacement for 2,4-D amine in the standard mixture of Embark (1/4 lb/A) + Telar (1/4 lb/A) + 0.5% X-77 Surfactant. Application on April 26, 1984 to 6 ft X 12 ft plots (4 replications) located between the fence and ditch on US 52 north of West Lafayette, IN adjacent to Purdue University Agronomy Farm (south edge). Applied by A.B. Hall, Dow, Cincinatti, using a CO_2 backpack sprayer fitted with 60 inch boom and T-jet nozzles (40 gpa/80 psi). Evaluations August 23.

	Fescue		Bluegrass	Orchard Grass		Timothy	
Treatment (all with 0.5% X-77 by volume)	SH/ft^2	Visual Ht	SH/ft^2	SH/ft^2	SH Ht	SH/ft^2	SH Ht
Control (all treatments with no Embark)	27±4	44±2	19± 5	15±2	43±4	10±2	40±3
Standard Mixture or Embark ± 2,4-D or Tordon	4±1	22±2	6± 3	6±3	30±4	8.5	33±4
Control in %	85%	50%	68%	60%	30%	15%	17%

At the time of treatment, fescue was approximately 12 inches tall and bluegrass was approximately 7 inches tall

Growth (subtracting 12 inches):			
Control (above)	32	31	28
Standard Mixture (above)	10	18	21
Control in %	69%	42%	25%

Treatment (all with 0.5% X-77 by volume)	Canadian Thistle	Total weeds	Weeds other than thistle
Control (all treatments with no 2,4-D or Tordon)	47 ± 16	84 ± 13	43 ± 6
(all treatments except Tordon alone)	69 ± 22		
2,4-D alone 2 lb/A	57 ± 50 (0-17%)		3 ± 3 (93%)
Embark + Telar + 2,4-D (Standard Mixture)	56 ± 40 (0-17%)		20 ± 9 (53%)
Embark alone	56 ± 47 (0-17%)		37 ± 27 (14%)
Embark + Telar + Tordon (1/2 lb/A or less)	83 ± 19 (0%)		36 ± 2 (16%)
Tordon alone or Tordon + 2,4-D (1/2 lb/A or less)	34 ± 13 (50%)		2 ± 1 (95%)
Tordon 1 lb/A alone	6 ± 6 (91%)		6 ± 7 (86%)
Embark 1/2 lb/A + Tordon 1 lb/A	20 ± 28 (71%)		5 ± 5 (88%)

Conclusions: The standard retardant mixture (or equivalent) in this experiment gave 85% control of fescue seedheads but only 68% control of bluegrass seedheads. Orchardgrass and timothy seedheads were controlled 30 and 17% respectively. Growth of fescue was reduced by about 70% giving an overall decrease in visual grass height of 50% or 22 inches shorter. Where weeds were not a problem, the plots did not appear to require mowing. Growth of orchardgrass and timothy were less affected, 42 and 25%, respectively. The standard mixture or 2,4-D or Embark alone did not appear to control thistle nor did any of the lower rates of Tordon or Tordon + 2,4-D in combination with Embark or Embark + Telar. Antagonism between Embark (Embark + Telar) and 2,4-D and/or Tordon was especially severe in this experiment. Weed control with the standard mixture was 53% compared to 93% for 2,4-D alone. Weed control at the lower rates of Tordon mixed with Embark + Telar was 16% compared to 95% with Tordon alone. Weed control with 1 lb/A Tordon mixed with Embark or Telar was however, was 88% compared to 86% for 1 lb/A Tordon alone. These comparisons are for weeds other than thistle. With Canadian Thistle, Tordon (± 2,4-D) at rates of 1/2 lb/A or less was about 50%; these rates were ineffective in the mixture. Tordon 1 lb/A gave 91% control of thistle alone but was reduced to 71% in the mixture. Replacing Telar with 1 lb/A DOWCO 356 did not reduce effectiveness on grass management and restored control of weeds other than thistle back to 88%. DOWCO 356 in the mixture was ineffective for control of Canadian thistle.

Table 69. Effect of rate of application of Cyanamid ACP-1900 applied in the presence of 0.25% X-77 surfactant (as percent of total spray mixture) on growth and seedhead parameters of fescue and bluegrass under roadside conditions. IN-126 test area. Plots 3 ft X 6 ft in three replicates. Applications were on May 2, 1984. Initial height of fescue was 11 inches. Initial height of bluegrass was 7 inches.

ACP-1900* (oz/A)	Data of September 13, 1984						Data of June 12, 1984				September 13 Total weeds per 50 ft^2
	Fescue			Bluegrass			Fescue		Bluegrass		
	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH ht	Bld Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	
0	18±0	41±1	22±3	11±5	25±6	21±5	18±3	38±1	10±1	26±3	7
1/8	9±7	33±5	24±4	7±3	24±4	19±5	10±4	29±4	13±4	24±6	6
1/4	5±4	26±0	24±5	12±8	24±5	18±3	7±6	27±2	14±9	25±5	14
1/2	5±2	28±4	17±1	5±1	21±3	17±5	8±2	28±3	10±2	22±2	14
1	1±0	20±6	17±1	3±1	19±5	15±1	2±1	28±8	7±8	20±2	9
2	0±0	-	14±2	1±0	15±1	13±1	1±1	9	1±1	13±2	9

* Experimental material from Cyanamid. Applied in the presence of 0.25% (of the total spray mixture) X-77 surfactant. 40 gpa. 40 psi.

SH = seedheads. SH Ht = seedhead height in inches. Bld Ht = extended blade length in inches.

Following treatment, control fescue grew 11 inches. Fescue treated with 1/2 oz/A ACP-1900 grew 6 inches and with 2 oz/A, 3 inches. Control bluegrass grew 14 inches. Bluegrass treated with 1/2 oz/A ACP-1900 grew 10 inches and with 2 oz/A, 6 inches. These measurements refer only to lengths of leaf blades. Thus, 1/2 oz/A of ACP-1900 gave 50% full season control of blade growth in fescue compared to 60% for the standard mixture of 1/4 lb/A of Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D plus surfactant in an adjacent test also applied on May 2. Seedheads in bluegrass were not controlled effectively in either test and the above mixture gave results comparable to 1 oz/A ACP-1900.

Table 70. Comparison of Cyanamid ACP-1900, 1 oz/A (+ 0.25% X-77 surfactant) with Schedule B (1/4 lb/A Embark + 1/4 oz/A Glean + 2 lb/A 2,4-D amine + 0.5% X-77 surfactant). Applications were on May 2, 1984. Evaluations were on June 12, 1984 and on September 12 and 13, 1984. Seedhead data are from June 12 and blade heights are from September 12 and 13. IN-126 test area.

	Fescue			Bluegrass		
Treatment	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht
ACP-1900, 1 oz/A	2±1	28±8	17±1	7±8	20±2	15±1
Schedule B	1±1	20±5	19±3	7±7	20±6	18±6

Table 71. Embark amount (lb/A as mefluidide) on seedhead formation and seedhead and blade height in fescue and bluegrass. Repeat application. Treatments were first applied on May 3, 1983. The second application, made one year later, was on May 3, 1984. IN-126 test site. Plots were 3' X 15' with triplicate evaluations. Initial height of fescue was 12 inches. That of bluegrass was 7 inches. Rained following application. Schedule B was applied (also a repeat application) 4 days later on May 7 in better weather. Evaluations were on June 20, 1984 (seedheads) and on September 21 (seedheads, blade height and weed control).

Amount				Fescue			Bluegrass			Weeds per
				Seedhead		Blade	Seedhead		Blade	
Embark	X-77	Telar	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	50 ft^2
-	-	-	-	18±1	40±6	24±0	22±2	24±3	19±1	22±2
1/4 lb	0.5%	1/4 oz	2 lb	2±2	29±0	24±1	14±1	19±1	17±1	3±1
1/8 lb	-	-	-	12±3	37±1	26±1	18±8	22±6	19±1	27±18
1/4 lb	-	-	-	11±1	37±1	22±2	27±21	24±2	18±2	25±15
1/2 lb	-	-	-	11±1	35±3	26±2	12±4	22±5	17±2	17±1
3/4 lb	-	-	-	12±0	38±2	25±2	10±6	19±2	17±1	11±5
1 lb	-	-	-	9±3	28±6	26±6	2±2	22±3	20±4	12±10
2 lb	-	-	-	7±5	25±3	26±6	1±3	21±1	20±5	11±9
1/8 lb	0.5%	-	-	10±5	37±3	23±1	4±6	24±5	17±3	11±5
1/4 lb	0.5%	-	-	12±5	36±3	21±1	4±1	20±3	17±1	13±5
1/2 lb	0.5%	-	-	11±6	35±2	26±2	3±2	20±2	17±1	11±1
3/4 lb	0.5%	-	-	11±6	32±7	22±2	2±1	15±4	18±2	12±6
1 lb	0.5%	-	-	3±1	29±1	22±2	0±1	16±1	22±4	6±6
2 lb	0.5%	-	-	5±4	32±5	25±3	no bluegrass present			1±1

Embark = lb/A as mefluidide; X-77 = % by volume of total spray mixture; Telar = oz/A chlorsulfuron; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

Possibly due to the rain following application, there was no obvious dose-dependency of the Embark application on fescue seedheads although seedhead height did show a dose dependency. A clear effect of surfactant was seen only with bluegrass seedheads.

Schedule B, applied in better weather at a different date, gave 90% control of fescue seedheads and 3/15 = 80% overall weed control.

These plots were located adjacent to a fence row adjacent to a pasture and the fescue was exceptionally robust.

Table 72. Telar amount (oz/A active material) on seedhead formation and seedhead and blade height in fescue and bluegrass. Repeat application. Treatments were applied first on May 4, 1983. The second application, one year later, was on May 3, 1984. IN-126 test area. Plots were 3' X 15 ft' with triplicate evaluations. Initial height of fescue was 12 inches. That of bluegrass was 7 inches. Rained following application. Schedules A and B were applied (also a repeat application) 4 days later on May 7 in better weather. Evaluations were on June 20, 1984 (seedheads) and on September 21 (seedheads, blade height and weed control).

Amount				Fescue			Bluegrass			Weeds per
				Seedhead		Blade	Seedhead		Blade	
Embark	X-77	Telar	2,4-D	Per ft^2	Height	Height	Per ft^2	Height	Height	50 ft^2*
-	-	-	-	18±2	44±7	36±1	7±1	27±5	22±1	4±1
1/2 lb	0.5%	-	2 lb	4±2	34±1	25±1	0±0	25	19±1	2±1
1/4 lb	0.5%	1/4 oz	2 lb	1±2	22±2	22±2	3±1	18±2	18±1	2±1
-	-	1/8 oz	-	15±1	39±3	26±1	5±0	27±1	23±2	4±1
-	-	1/4 oz	-	14±2	43±2	26±2	4±0	28±2	21±1	6±6
-	-	1/2 oz	-	11±3	41±6	27±3	2±1	31±5	24±0	3±3
-	-	3/4 oz	-	13±1	38±1	34±4	6±0	28±2	21±3	6±0
-	-	1 oz	-	7±1	35±5	31±3	5±2	25±5	28±7	1±1
-	-	2 oz	-	3±1	30±5	31±3	5±3	27±5	16±4	5±5
-	-	4 oz	-	3±1	24±4	23±3	5±0	22±4	24±4	5±5
-	0.5%	1/8 oz	-	15±4	41±2	29±7	6±3	31±5	17±2	3±3
-	0.5%	1/4 oz	-	9±6	38±7	27±6	5±4	26±8	17±2	2±1
-	0.5%	1/2 oz	-	16±2	40±3	28±5	8±2	30±2	23±1	5±5
-	0.5%	3/4 oz	-	12±5	40±4	26±8	5±2	27±4	19±4	3±3
-	0.5%	1 oz	-	1±1	16±2	20±2	5±0	19±2	23±3	3±3
-	0.5%	2 oz	-	4±4	31±3	24±4	11±8	28±5	20±2	3±3
-	0.5%	4 oz	-	3±1	21±10	21±3	16±1	26±5	22±3	0±0

Embark = lb/A as mefluidide; X-77 = % by volume of total spray mixture; Telar = oz/A chlorsulfuron; 2,4-D = lb/A of acid equivalent of the dimethylamine salt.

* Mostly 2,4-D resistant species including groundcherry, bindweed, milkweed and thistle

Schedule B, applied in better weather at a different date, gave 95% control of fescue seedheads and 4/2 = 50% control of weeds. As a single agent, with or without surfactant, Telar was inactive at rates less than 1 oz/A in this experiment.

Plots were located adjacent to a fence row.

Table 73. Effect of a second year application of varying amounts of DPX-T-6376-2960 (DuPont) on seedhead formation, growth and broadleaf weeds. The first application was on May 5, 1983. The second year application was on May 7, 1984. The primary evaluation on seedheads was from June 18, 1984 and confirmed on September 14, 1984. Blade length was measured on September 14, 1984. Weed control evaluations were on September 17, 1984. IN-126 test area. Plots were 6' X 7.5'. Initial heights were 15 inches for fescue and 11.5 inches for bluegrass. 3 replicates.

Amount					Fescue			Bluegrass			Weeds
Embark	WK	Glean	DPX*	2,4-D	SH/ft^2	SH ht	Bld ht	SH/ft^2	SH ht	Bld ht	per 50 ft^2
-	-	-	-	-	22±4	44±3	27±0	5±2	27±4	22±1	10±10
1/2 lb	0.5%	-	-	2 lb	6±2	30±3	23±3	1±2	18±5	19±6	0±0
1/4 lb	0.5%	1/4 oz	-	2 lb	6±5	27±4	24±4	2±2	24±5	21±6	1±1
-	-	-	1/16 oz	-	8±8	32±12	26±3	3±3	25±11	21±2	2±2
-	-	-	1/8 oz	-	7±6	31±12	23±1	4±3	23±8	19±1	1±1
-	-	-	1/4 oz	-	6±3	26±4	28±5	3±2	25±5	20±2	1±1
-	-	-	3/8 oz	-	5±5	30±5	24±2	3±0	26±2	22±1	2±2
-	-	-	1/2 oz	-	6±2	26±1	23±2	3±1	24±1	20±1	2±2
-	-	-	1 oz	-	6±2	29±3	23±2	3±1	26±2	21±2	2±2
-	-	-	2 oz	-	3±2	26±1	23±1	6±3	28±2	23±2	1±1
-	-	-	4 oz	-	3±2	22±9	22±1	8±4	25±2	21±2	2±2
-	0.5%	-	1/16 oz	-	9±7	27±2	25±2	6±2	31±3	23±2	2±1
-	0.5%	-	1/8 oz	-	7±2	30±2	25±1	8±1	24±3	20±2	4±2
-	0.5%	-	1/4 oz	-	5±2	30±8	24±1	6±1	28±4	20±2	3±1
-	0.5%	-	3/8 oz	-	4±5	15±3	29±0	4±4	23±4	22±0	8±4
-	0.5%	-	1/2 oz	-	9±2	22±2	26±2	2±1	22±2	20±2	0±0
-	0.5%	-	1 oz	-	7±5	31±3	26±3	7±6	29±2	26±3	0±0
-	0.5%	-	2 oz	-	6±2	19±2	24±2	10±5	27±4	22±1	0±0
-	0.5%	-	4 oz	-	4±1	19±2	18±1	13±3	30±3	17±5	1±1

Embark = lb/A as mefluidide; WK = % by volume of total spray mixture; Telar = oz/A of active material; DPX=DPX-T6376-2960 as oz/A of active material; 2,4-D = lb/A of acid equivalent of the dimethylamine salt. SH = seedheads; SH ht = height of seedheads in inches; Bld ht = extended blade length in inches.

At the end of the growing season, there was no evidence of overt phytotoxicity from any of the treatments. Grass appeared healthy.

Table 74. Substitution of Mon 6421 (Monsanto) or ACP 1900 (Cyanamid) for Embark or Telar in the basic mixture with 0.5% X-77 surfactant and 2 lb/A 2,4-D amine. Treatments applied May 8, 1984. 18 ft^2 plots in 3 replications. IN-126 test area. Cold and windy at time of application. Initial height of fescue was 9.5 inches; that of bluegrass 8.5 inches. Evaluations were on June 12, 1984 and on September 16, 1984. Seedhead data are from June 12 with confirmation on September 16. Blade heights and weed control information are from September 16.

Amount						Fescue			Bluegrass			Weeds
Embark	X-77	Telar	2,4-D Amine	Mon 6421	ACP-1900	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	per 18 ft^2
-	-	-	-	-	-	13±1	36±0	19±1	8±1	21±1	13±0	7±1
1/8 lb	0.5%	1/8 oz	2 lb	-	-	0±1	11±3	14±3	5±7	14±1	12±2	1±1
1/4 lb	0.5%	-	2 lb	1/2 lb	-	3±4	25±7	13±1	12±16	16±0	14±4	0±1
-	0.5%	-	2 lb	1 lb	-	13±8	27±3	16±2	8±7	21±1	14±1	0±0
-	0.5%	1/4 oz	2 lb	1/2 lb	-	1±1	21±9	15±1	10±6	22±2	16±1	1±1
1/4 lb	0.5%	-	2 lb	-	1/8 oz	0±0	13±8	13±1	7±4	15±4	13±2	1±2*
-	0.5%	-	2 lb	-	1/4 oz	2±1	21±2	16±1	9±6	23±8	16±4	0±0
-	0.5%	1/4 oz	2 lb	-	1/8 oz	1±1	16±6	16±3	8±3	22±4	15±1	0±0

Mon 6421 at the rate tested was ineffective as a single agent on fescue. ACP-1900 was effective both as a single agent at 1/4 oz/A and in combination with either Telar or Embark at 1/8 oz/A. ACP-1900 appears compatible with 2,4-D amine giving 85-100% control of broadleaf weeds.

Table 75. Rate of application of Cyanamid ACP-1900 and Monsanto Mon 4621 on seedhead and growth parameters of fescue and bluegrass. Applications were on May 9, 1983. Good weather. IN-126 test area. Plots 3 ft X 6 ft in 3 replications. 40 gpa. 40 psi. Initial height of fescue was 9 inches; bluegrass 7 inches. Evaluations were on June 16, 1984 (seed heads) and September 17, 1984 (confirmation of seedhead data, blade height and weed control information).

Amount		Fescue			Bluegrass			Weeds
ACP-1900	Mon 4621	SH/ft^2	SH ht	Bld Ht	SH/ft^2	SH ht	Bld Ht	per 18 ft^2
-	-	17±1	39±1	17±1	9±6	21±1	15±1	6±2
1/2 oz/A	-	11±6	27±2	17±3	11±6	21±5	13±3	4±3
1 oz/A	-	9±0	25±4	15±2	11±9	18±5	12±3	4±7
2 oz/A	-	8±3	19±2	17±2	7±2	17±3	11±1	3±3
4 oz/A	-	9±4	18±2	14±2	11±2	16±4	13±2	3±2
-	4 lb/A	16±4	36±4	21±0	11±6	21±3	16±3	6±4
-	8 lb/A	14±3	27±4	17±2	8±3	22±1	19±1	6±4
-	16 lb/A	12±1	28±4	20±1	6±1	23±4	16±4	3±2
-	32 lb/A	6±3	22±2	15±1	5±2	20±1	11±1	4±2

SH = seedheads; ht = height in inches; Bld Ht = extended length of leaf blades in inches. Neither material alone at this date of application gave satisfactory control of seedheads of fescue at any rate of application.

Table 76. Comparison of Embark, Telar, DPX-T6376-2960, Cyanamid ACP-2900 in various combinations with 2,4-D amine and X-77 surfactant on growth and seedhead parameters of fescue and bluegrass. Applications were on May 10, 1984. Weather was cool and windy. Initial grass heights not recorded. Evaluations were on June 16, 1984 (seedheads) and September 17, 1984 (seedheads, blade height and weeds). 40 gpa. 40 psi. IN-126 test area.

Amount						Fescue			Bluegrass			Weeds
Embark	X-77	Telar	DPX	ACP-2900	2,4-D amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	per 18 ft^2
-	-	-	-	-	-	17±1	37±1	17±1	13±6	21±3	16±1	6±6
1/4 lb	0.5%	1/4 oz	-	-	2 lb	0±1	21±4	17±1	8±6	17±3	14±1	1±2
1/8 lb	0.5%	-	1/16 oz	-	2 lb	2±2	22±4	15±1	18±8	19±2	15±2	1±1
1/4 lb	0.5%	-	1/8 oz	-	2 lb	1±1	17±3	15±2	4±3	16±3	13±1	1±2
1/4 lb	0.5%	-	-	1/2 oz	2 lb	6±5	20±2	20±3	3±3	21±5	16±1	0±1
-	0.5%	1/4 oz	-	1/2 oz	2 lb	4±5	20±3	18±2	7±5	20±2	16±4	0±1

ACP-2900 in the basic mixture to replace either Embark or Telar gave 70% control of fescue seedheads compared to 90 to 100% control with Embark + Telar or Embark + DPX-T6376-2960 in the mixture. Weed control was 90 to 100% for all treatments. With bluegrass, Schedule B gave only 40% control while ACP-2900 + Embark was 77% effective and ACP-2900 + Telar was similar to that with Schedule B.

Table 77. Comparison of Embark + Telar vs. Embark alone (with 2 lb/A 2,4-D Amine and 0.5% X-77 surfactant) on growth and seedhead parameters of fescue and bluegrass. IN-126 test area. Application was on May 9, 1984. At the time of application fescue was 9 inches, bluegrass was 7 inches. 6 ft X 18 ft plots. 40 gpa. 40 psi. Evaluations were on June 16 (seedheads) and September 17 (seedheads, blade height and weed control), 1984.

Amount				Fescue			Bluegrass			Weeds per
Embark	X-77	Telar	2,4-D Amine	SH/ft^2	SH ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	100 ft^2
-	-	-	-	17±1	37±1	17±1	8±2	22±2	14±1	57
1/4 lb	0.5%	1/4 oz	2 lb	0±1	8±5	15±2	3±3	13±2	10±1	13
1/2 lb	0.5%	-	2 lb	5±2	31±1	17±1	2±1	16±1	12±1	15

SH = seedheads; ht = height in inches; Bld Ht = extended length of leaf blades in inches.

Weed species included composites (white heath aster plus ironweed), 27; common thistle, 3; whorled milkweed, 7; bindweed 8; ragweed,10 and other, 2. With 1/2 lb/A Embark + 2 lb/A 2,4-D the only species remaining was wild carrot. With the mixture of Embark + Telar, the dominant species were ironweed and late germinating ragweed. Overall weed control was 75%.

Wild garlic Experiments:

Wild garlic sprayed with a mixture of 1/4 lb/A Embark (as mefluidide) + 1/4 oz/A Telar (active ingredient) + 2 lb/A 2,4-D amine (acid equivalent) + 0.5% of the total spray mixture of X-77. 40 psi. 40 gpa.

Applications were on: May 9
May 10*
May 14
May 16
May 20

*Garlic mowed to a height of 4 inches prior to spraying.

Plants sprayed on May 9 and 10 were already dying and no longer unsightly by May 14. By May 20 these plants were dead (above ground parts). Similar results were observed from the applications on May 14, May 16 and May 20. No regrowth was evident by September 17, 1984.

Table 78. Cyanamid ACP-2900 in the presence and absence of various components of growth retardant mixture on seedhead and growth parameters of fescue and bluegrass. Applications were on May 12. Cool, clear and bright. IN-126 test area. Initial height of fescue 11 inches. Initial height of bluegrass 8 inches; 5 seedheads/ft^2 already formed. No seedheads for fescue. 3 ft X 18 ft plots in 3 replicates. 40 gpa. 40 psi. Evaluations were on June 16, 1984 (seedheads) and September 18, 1984 (seedheads and blade height).

Amount						Fescue			Bluegrass			Weeds
Embark	X-77	DPX-T6376 Telar	DPX-T6376 2960	ACP-2900	2,4-D Amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	per 18 ft^2
-	-	-	-	-	-	17±1	41±3	21±1	11±2	24±3	17±1	8±4
-	-	-	-	1/2 oz	-	2±1	22±3	18±4	20±7	22±3	14±1	5±1
-	0.5%	-	-	1/2 oz	-	3±0	19±3	18±3	13±5	20±3	14±1	5±3
-	0.5%	-	-	1/2 oz	2 lb	7±4	23±3	20±3	13±6	23±4	15±4	0±1
-	0.5%	-	1/8 oz	1/2 oz	2 lb	3±1	23±3	19±3	6±3	21±4	16±4	1±1
-	0.5%	1/4 oz	-	1/2 oz	2 lb	1±1	19±4	18±4	12±5	22±0	17±4	1±1
1/4 lb	0.5%	-	-	1/2 oz	2 lb	0±0	-	18±1	9±4	16±1	14±1	1±1
1/4 lb	0.5%	-	-	1/2 oz	-	0±1	18±3	19±2	5±5	11±1	14±2	4±1

SH = seedheads. SH Ht = height of seedheads in inches. Bld Ht = extended length of leafblade in inches. Amounts are in rate per acre of active ingredient except for X-77 surfactant which is in percent of the total spray mixture.

At this date of application 1/2 oz/A of ACP-2900 alone gave 90% control of fescue seedheads and stimulated the formation of bluegrass seedheads. Addition of surfactant had little effect except to reduce the number of bluegrass seedheads and the seedhead height of both bluegrass and fescue. Inclusion of 2 lb/A 2,4-D had a negative effect on fescue seedheads but not on bluegrass seedheads. Combination with 1/8 oz DPX-T6376-2960 resulted in no further formation of bluegrass seedheads (there were 5 bluegrass seeheads/ft^2 at the time of application) while addition of 1/4 oz of Telar was essentially without effect. The combination of 1/4 lb/A Embark + surfactant + 1/2 oz/A ACP-1900 was the most effective treatment overall either with or without 2,4-D.

Overall weed control resulting from the 2,4-D was about 80%.

Table 79. Comparison of several herbicides in combination with Embark, Telar, 2,4-D Amine and X-77 Surfactant for vegetation management along secondary roads with emphasis on control of giant foxtail and annual weeds[a].

Experiment/Treatment	Tall Fescue SH/ft^2	Tall Fescue SH Ht	Tall Fescue Bld Ht	Bluegrass SH/ft^2	Bluegrass SH Ht	Bluegrass Bld Ht	Smooth Brome SH/ft^2	Smooth Brome SH Ht	Orchardgrass SH/ft^2	Orchardgrass SH Ht	Timothy SH/ft^2	Timothy SH Ht	Foxtail[b] per 10 ft^2	Foxtail[b] Ht	Weeds[d]/30 ft^2
Expt 84-24 Applied May 14															
Control	20±4	38±1	20±4	17±4	26±4	17±5	12±0	40±2	12	39	6	29	8±3	32±10	21
Standard Mixture[c]	0±0	0±0	22±3	12±4	21±4	16±4	12±1	38±0	-	-	-	-	26±8	32±3	9
+ DPX-F6025 1/4 oz	1±2	20	25±1	13±2	18±2	17±2	13±1	41±4	12±0	42±0	-	-	28±12	39±3	16
+ Balan 1.5 lb/A	0±0	0±0	25±2	15±4	21±1	16±1	13±1	37±5	-	-	-	-	28±6	42±6	13
+ Balan 3 lb/A	5±8	38	26±2	11±1	17±3	16±1	13±1	42±2	14	43	-	-	2±4	23±4	2
+ DPX-F6025 1/4 oz + Balan 1.5 lb/A	0±0	0±0	22±4	13±1	20±4	15±1	12±0	40±2	-	-	-	-	24±14	31±6	13
+ DPX-F6025 1/4 oz + Balan 3 lb/A	0±0	0±0	20±3	14±3	19±2	15±1	13±2	37±1	14±0	27±1	-	-	7±4	23±10	8
DPX-F6025 1/4 oz alone	19±1	37±2	19±3	18±5	24±3	18±2	14±2	37±1	-	-	-	-	23±12	29±16	14
Balan 1.5 lb/A alone	16±2	39±6	31±5	13±1	27±1	18±2	19±6	42±6	-	-	8	38	25±10	37±10	7
Balan 3 lb/A alone	21±1	38±1	23±3	13±1	25±4	16±1	15±2	36±2	-	-	3±1	31±10	10±9	31±12	30
Expt 84-25 Applied May 15															
Control	17±1	38±3	23±1	20±7	25±4	17±2	13±1	36±1	12	35	10	37	17±9	27±6	37
Standard Mixture[c]	0±0	0±0	26±2	15±1	19±5	14±1	13±1	42±3	8±2	27±1	11±1	28±0	11±1	30±5	9
+ Betasan 20 lb/A	0±0	0±0	22±3	14±3	18±3	16±1	15±3	41±3	-	-	-	-	3±6	28±6	12
+ Surflan 1.5 lb/A	1±2	26	24±3	14±3	23±5	15±2	15±3	40±5	-	-	11±1	31±1	5±4	21±2	17
+ Prowl 1.5 lb/A	2±3	19	20±1	16±2	23±1	17±2	14±2	37±1	12±0	41±5	13±1	30±3	8±4	19±2	16
+ Fusilade 0.4 lb	1±1	26	25±1	15±4	19±1	17±1	13±1	43±1	12±0	31±8	3	36	17±18	25±11	17
+ Poast 0.3 lb/A	0±0	0±0	21±4	13±1	20±4	14±2	5±2	25±6	3±2	11±10	-	-	13±7	19±7	31
+ Goal 0.5 lb/A	7±5	19±5	22±1	14±3	20±2	15±1	13±1	42±4	12	32	3	27	9±3	33±3	1
+ Hoelon 1.25 lb/A	3±5	32	26±6	12±0	20±2	17±1	12±0	37±1	12±1	34±2	11±0	31±1	11±6	30±7	11
Expt 84-27 Applied May 17															
Control	19±1	44±0	25±3	15±3	22±2	15±2	13±1	38±1	-	-	11±1	36±0	14±5	25±2	54
Standard Mixture[c]	4±5	22±5	21±1	15±4	20±2	14±3	13±1	44±5	12±0	24±3	10±6	30±6	8±2	22±8	11
+ Betasan 5 lb/A	1±2	21	24±4	19±5	21±1	16±4	12	36	17±2	42±3	-	-	6±1	18±1	8
+ Betasan 10 lb/A	2±1	25±1	27±2	15±4	21±1	16±1	13±1	36±1	11±1	26±3	10±2	28±4	9±3	31±13	15
+ Betasan 15 lb/A	0±0	0±0	26±1	16±2	20±3	15±1	13±1	41±5	11±1	31±4	-	-	14±7	39±4	11
+ Betasan 20 lb/A	10±3	25±9	28±7	21±4	23±4	18±4	13±1	37±1	18±4	36±2	12±2	33±2	8±2	27±9	10
+ DPX-F6025 1/4 oz + Betasan 20 lb/A	16±2	30±3	26±1	15±4	19±3	14±2	14±0	34±3	-	-	-	-	12±1	16±1	10
Betasan 5 lb/A alone	-	-	-	19±1	24±2	16±2	12±2	35±2	-	-	-	-	5±4	26±11	6
Betasan 10 lb/A alone	-	-	-	15±4	25±2	17±1	10±2	37±1	-	-	-	-	4±2	29±7	13
Betasan 15 lb/A alone	-	-	-	14±0	26±1	19±3	-	-	13±1	36±1	-	-	4±4	25±9	28

Continued Next Page

Table 79 Continued. Comparison of several herbicides in combination with Embark, Telar, 2,4-D Amine and X-77 Surfactant for vegetation management along secondary roads with emphasis on control of giant foxtail and annual weeds[a].

Experiment/Treatment	Tall Fescue SH/ft^2	Tall Fescue SH Ht	Tall Fescue Bld Ht	Bluegrass SH/ft^2	Bluegrass SH Ht	Bluegrass Bld Ht	Smooth Brome SH/ft^2	Smooth Brome SH Ht	Orchardgrass SH/ft^2	Orchardgrass SH Ht	Timothy SH/ft^2	Timothy SH Ht	Foxtail[b] per 10 ft^2	Foxtail[b] Ht	Weeds[d]/ 30 ft^2
Expt 84-28 Applied May 18															
Control	-	-	-	17±4	27±2	19±2	-	-	14±0	37±0	2±1	33±1	19±10	34±12	23
Standard Mixture[c]															
+ Betasan 10 lb/A 0.25% X-77	-	-	-	16±3	22±3	17±3	13±1	35±3	13±5	38±5	-	-	7±4	28±7	16
+ Betasan 10 lb/A 0.5% X-77	-	-	-	17±2	23±4	17±2	14±2	43±1	14	35	-	-	23±15	39±6	9
+ Balan 3/4 lb/A	0	0	23	17±3	25±2	17±2	14±0	41±4	-	-	14	27	30±8	41±4	28
+ Surflan 1 lb/A	-	-	-	17±1	23±2	16±1	12±0	36±0	-	-	-	-	19±7	33±7	19
+ Goal 0.25 lb/A	-	-	-	19±1	27±2	20±2	13±1	38±1	-	-	-	-	10±5	26±6	5
+ Hoelon 3/4 lb/A	-	-	-	19±1	25±2	20±3	-	-	-	-	12	21	5±6	25±8	7
+ Poast 0.2 lb/A	-	-	-	13±2	22±6	18±0	14±0	37±1	-	-	-	-	6±5	31±8	5
+ Fusilade 0.25 lb/A	0±0	0±0	21±2	16±0	21±1	16±1	-	-	-	-	-	-	29±19	21±2	30
+DPX-F6025 1/4 oz/A	-	-	-	16±0	20±1	17±1	13±1	41±2	-	-	12±0	35±1	16±4	44±5	4

[a] Treatments applied May 14-May 18, 1984. Final evaluations on August 21, 1984. Plots approximately 6 ft X 100 ft. Located along county road adjacent to Baker Purdue Farm. Clear and cool at time of spraying on May 14. Less than 10 mph wind on May 15. Fair, warm and dry on May 17 with slight wind. May 18 similar to May 17. Fescue height at time of spraying 18-20 inches; smooth brome 24 inches; no seed heads on either species. Bluegrass 14±2 inches tall with approximately 15 seed heads/ft^2 already formed at the time of spraying up to 25 seedheads/ft^2.

[b] Includes predominantly giant foxtail but some yellow foxtail as well.

[c] The standard mixture consisted of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D amine (applied as active ingredient mefluidide, chlorsulfuron and 2,4-D acid equivalent, respectively) + 0.25% X-77 surfactant (vol/vol of total spray mixture).

[d] Not including canadian thistle which was not controlled by any of the treatments and was numerous in some plots but absent from others. Species present included dandelion, plantain, ground cherry, horse nettle, mint, bindweed, red clover, common, climbing and whorled milkweed, curled dock, common spurge, common ragweed, lambsquarter, wild buckwheat, pokeweed, wild lettuce, wild strawberry and yellow wood sorrell.

Note: Rates of materials added to the standard mixture are all given in lbs (oz) per acre of active material. Applied at 40 gpa total spray mixture with a pressure of 40 psi (8004 Spraying Systems nozzle).

SH = seed heads; SH Ht = height of seed heads in inches; Bld Ht = extended blade lenght in inches.

Table 80. Summary of herbicides in combination with Embark, Telar, 2,4-D Amine and X-77 Surfactant for vegetation management along secondary roads with emphasis on control of giant foxtain and annual weeds. Applied May 14-May 18, 1984. Evaluations on August 21. Baker-Purdue Farm. For details, see previous Table.

Treatment	Tall Fescue			Bluegrass			Smooth Brome		Orchardgrass		Timothy		Foxtail			Weeds	
	SH/ft^2	SH Ht	Bld. Ht	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	SH/ft^2	SH Ht	per 10 ft^2	Ht	% Cont	per 30 ft^2	% Cont
Control	19±2	40±3	23±3	17±3	24±2	16±1	13±1	37±2	13±1	37±2	9±3	34±4	15±5	30±4	0	37±17	0
Standard Mix[a]	1±2	22±5	23±3	14±2	20±1	15±1	13±1	41±3	10±1	26±2	10±1	29±2	15±10	28±5	0	10±1	73
+ Poast[b,c]	0±0	0±0	21±4	13±1	20±4	14±2	5±2	25±6	3±2	11±10	-	-	10±3	19±7	33	18	51
+ Balan[b]	0±0	0±0	20±3	14±3	19±3	15±1	13±2	37±1	14±0	27±1	-	-	2±4	23±4	67	2	95
+ Betasan	0±0	0±0	22±3	14±3	18±3	16±1	15±3	41±3	-	-	-	-	6±3	28±6	80	12	68
+ Goal	7±5	19±5	22±1	14±3	20±2	15±1	13±1	42±4	12	32	3	27	9±3	33±3	40	3	92
+ Hoelon	3±5	32	26±6	12±0	20±2	17±1	12±0	37±1	12±1	34±2	11±0	31±3	8±3	30±7	47	9	76
+ Prowl	2±3	19	20±1	16±2	23±1	17±2	14±2	37±1	12±0	41±5	13±1	30±3	8±4	19±2	47	16	57
+ Surflan	1±2	26	24±3	14±3	23±5	15±2	15±3	40±5	-	-	11±1	31±1	5±4	21±2	67	10	73
+ Fusilade	1±1	26	25±1	15±4	19±1	17±1	13±1	43±1	12±0	31±8	3	36	17±18	25±11	0	4	89
+ DPX-F6025	1±2	20	25±1	13±2	18±2	17±2	13±1	41±4	12±0	42±0	-	-	16±4	39±3	0	10	73

[a] The standard mixture consisted of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D amine (applied as active ingredient; mefluidide, chlorsulfuron and 2,4-D acid equivalent, respectively) + 0.25% X-77 surfactant (vol/vol of total spray mixture).

[b] Rates are the highest rates tested as shown in the previous table. No phytotoxicity was noted from any of the materials included in the table.

[c] Poast was the only treatment where the appearance of the plot was acceptible overall. Seedheads of smooth brome and orchard grass were reduced in number and short. Canada thistle, while not killed, was shorter in the plot, spindly and less prone to form blossoms. Thistle in the check plot was 31±1 inches tall and 100% of the plants had formed blooms. In the Poast plot, the thistle was 14.5 ± 2.5 inches tall and only 7% of the plants had produced blooms.

Note: DPX-F6025 was without effect on the mixture. Fusilade gave somewhat better weed control but was ineffective against foxtail. Surflan controlled foxtail but was ineffective in enhancing the mixture in other respects. Prowl gave some foxtail control as did Hoelon but was equal to the standard mixture or poorer in other respects. Goal and Hoelon gave some foxtail but reduced effectiveness on fescue. Betasan at 20 lb/A appeared to give good foxtail control was was ineffective in enhancing the overall effectiveness of the mixture. Balan at 3 lb/A gave good foxtail control and appeared to enhance control of broadleaf weeds. Poast was of greatest interest due to enhancement of activity of the mixture against smooth brome and orchardgrass with some control of foxtail and perhaps slightly less activity for weed control. It was better against bluegrass and did not reduce effectiveness against fescue. A rate of 0.2 lb/A was not as effective as 0.3 lb/A and the rate should be increased to 0.4-0.5 lb/A in future tests. Care should be exerted in application of this material since it may become phytotoxic at the higher rates.

Table. 81. Comparison of Schedule A, Schedule B, Schedule C and modified Schedules B and C on seedhead and growth parameters of fescue and bluegrass. IN-126 test area. Applications were on May 16, 1984. Fescue was 14 inches tall. Bluegrass was 12 inches tall with 8 seedheads/ft^2. No fescue seedheads had yet formed. 40 gpa. 40 psi. Evaluations were on June 18, 1984 (seedheads) and September 19, 1984 (seedheads, blade length and weed control). 3 ft X 6 ft plots in 3 replications.

	Amount					Fescue			Bluegrass			
Schedule	Embark	X-77	Telar	DPX-T6376-2960	2,4-D amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	Total weeds
-	-	-	-	-	-	31±10	30±2	24±1	11±3	27±5	17±1	6
C	1/8 lb	0.5%	1/8 oz	-	2 lb	0+1	18±1	17±1	13±1	17+2	16±1	0
B	1/4 lb	0.5%	1/4 oz	-	2 lb	1±2	16±5	17±2	11±1	16±2	14±1	5
-	1/8 lb	0.5%	-	1/16 oz	2 lb	0±1	16±4	17±2	11±4	19±3	15±2	0
-	1/4 lb	0.5%	-	1/8 oz	2 lb	0±0	12±1	15±1	11±2	16±3	14±1	0
A	1/2 lb	0.5%	-	-	2 lb	10±1	33±3	18±1	13±2	18±2	13±3	0

SH = seedheads. Bld Ht = length of leaf blade (extended) in inches. Ht = height in inches. Amounts of materials are in rates per acre of active materials except for X-77 which is percent of the total spray mixture.

At this late date of application Schedule A (Embark + Surfactant + 2,4-D) was ineffective in preventing the formation of fescue seedheads whereas schedules B and C (containing Telar) or where Telar was replaced by DPX-T6376-2960, were very effective giving between 97 and 100 control of fescue seedheads. Bluegrass seedheads were largely already emerged and the greatest effects were seen in a reduction in seedhead height only. There were insufficient weeds in the experiment to permit an evaluation of weed control.

Table 82. Summary of comparisons of Schedule A, Schedule B, Schedule C and modified Schedules B and C on seedhead formation in fescue and bluegrass comparing all 1984 dates of application. IN-126 test area.

	Number of Seedheads, % of Control									
	Fescue					Bluegrass				
Date of application	Sch C 1/8E+1/8T	Sch B 1/4E+1/4T	1/8E+1/16DPX	1/4E+1/8DPX	Sch A 1/2E	Sch C 1/8E+1/8T	Sch B 1/4E+1/4T	1/8E+1/16DPX	1/4E+1/8DPX	Sch A 1/2E
April 7	92	99	94	98	98	75	50	75	75	95
April 10	68	68	68	71	74	53	53	47	53	74
April 18	85	95	85	90	90	52	20	52	60	84
April 25	95	93	92	96	89	64	79	89	74	98
April 26	-	90	-	-	93	-	29	-	-	88
May 2	91	74	96	96	52	(0)	(0)	(0)	(0)	(0)
May 7	-	89	-	-	-	-	36	-	-	-
May 7	-	94 } 85	-	-	78 } 75	-	57 } 51	-	-	100 } 90
May 7	-	73	-	-	73	-	60	-	-	80
May 8	100	92	-	-	-	38	0	-	-	-
May 9	-	100	-	-	71	-	63	-	-	75
May 10	-	100	88	94	-	-	38	0	69	-
May 14	-	100 } 95	-	-	-	-	30 } 26	-	-	-
May 15	-	100	-	-	-	-	25	-	-	-
May 17	-	79	-	-	-	-	0	-	-	-
May 16	100	97	100	100	67	(0)	(0)	(0)	(0)	(0)
Average	90±11	88±11	89±11	92±10	79±15	56±14	44±20	53±34	66±9	86±9

E = Embark (as mefluidide); T = Telar (as chlorsulfuron); DPX = DPX-T6376-2600 (as active material). Rates are lb/A for Embark and oz/A for Telar and DPX. All treatments contained 2 lb/A 2,4-D amine (acid equivalent) and 0.5% X-77 surfactant as % of the total spray mixture applied at 40 gpa and 40 psi.

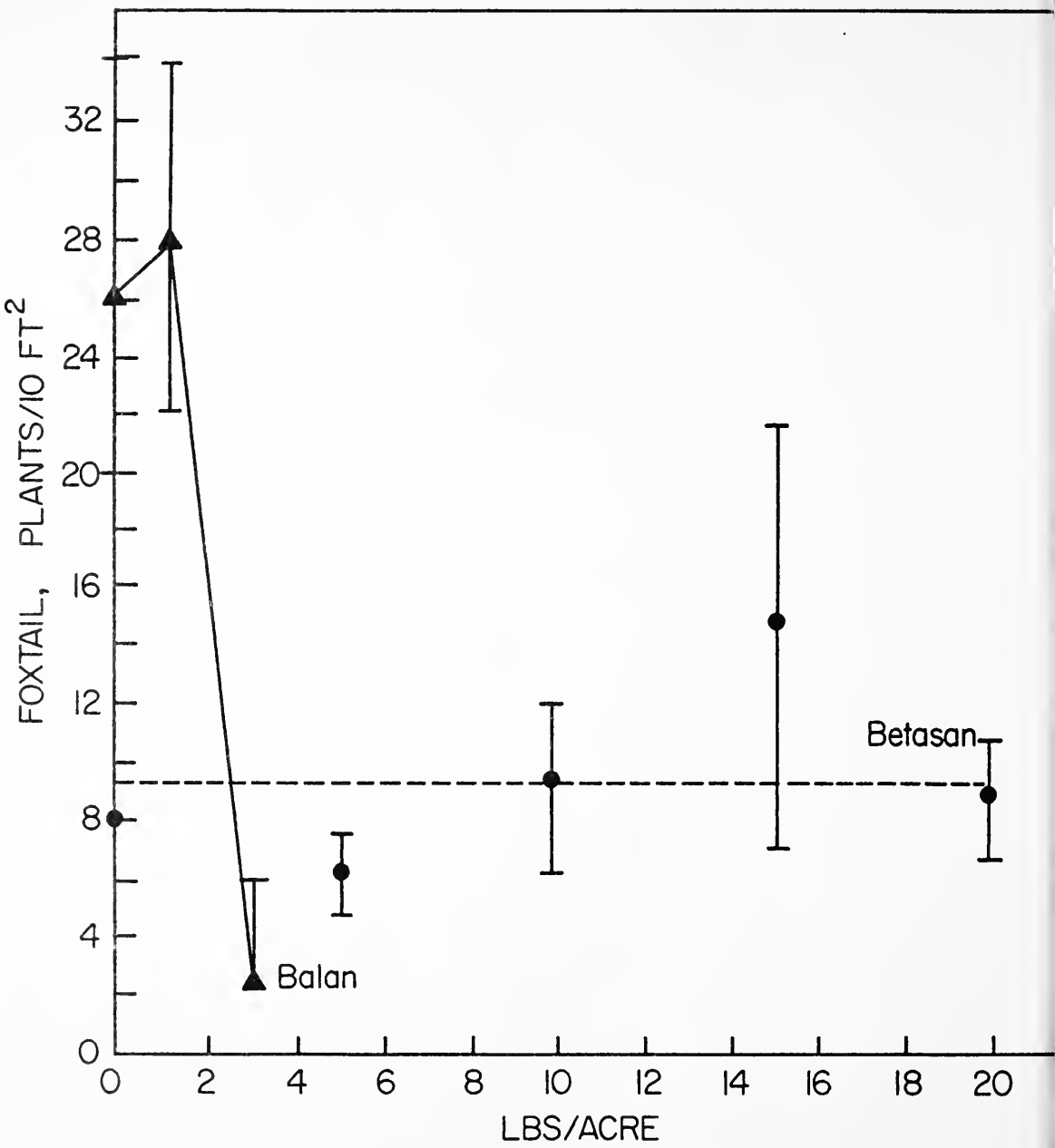
Table. 83. Comparison of Schedule A, Schedule B, Schedule C and modified Schedules B and C on seedhead and growth parameters of fescue and bluegrass. IN-126 test area. Applications were on May 26, 1984. Fescue was 22 inches tall*with 12 seedheads/ft^2. Bluegrass was 15 inches tall*with 4 seedheads/ft^2. 40 gpa. 40 psi. 40 gpa. Evaluations were on June 18, 1984 (seedheads) and on September 20, 1984 (seedheads, blade length and weed control). 3 ft X 6 ft plots in 3 replications.

	Amount					Fescue			Bluegrass			Weeds/18 ft^2	
Schedule	Embark	X-77	Telar	DPX-T6376-2600	2,4-D Amine	SH/ft^2	SH Ht	Bld Ht	SH/ft^2	SH Ht	Bld Ht	Whorled Milkweed	Other Weeds
-	-	-	-	-	-	17±1	36±1	16±1	9±1	24±3	14±1	2±2	23±6
C	1/8 lb	0.5%	1/8 oz	-	2 lb	11±4	22±2	16±1	6±2	18±3	13±2	1±1	1±1
B	1/4 lb	0.5%	1/8 oz	-	2 lb	11±2	20±6	14±3	7±1	16±2	12±1	2±2	3±5
-	1/8 lb	0.5%	-	1/16 oz	2 lb	7±5	20±3	14±1	5±0	16±3	12±1	2±2	0±1
-	1/4 lb	0.5%	-	1/8 oz	2 lb	8±4	20±1	16±2	4±2	16±1	12±0	1±1	2±1
A	1/2 lb	0.5%	-	-	2 lb	10±6	25±5	17±4	5±1	18±1	13±2	3±3	1±1

SH = seedheads. SH Ht = height of seedheads in inches. Bld Ht. = extended length of leaf blade in inches. Amounts of materials are in rates per acre of active materials except for X-77 which is percent of the total spray mixture.

* Initial height including seedheads. Schedule B and modified schedules B and C both prevented further seedhead development and elongation in both bluegrass and fescue even at this late date of application. With schedule A, seedhead formation was prevented but seed head elongation continued for an additional 3 inches before growth was halted.

Overall weed control was 95% except for wholed milkweed which was not controlled.



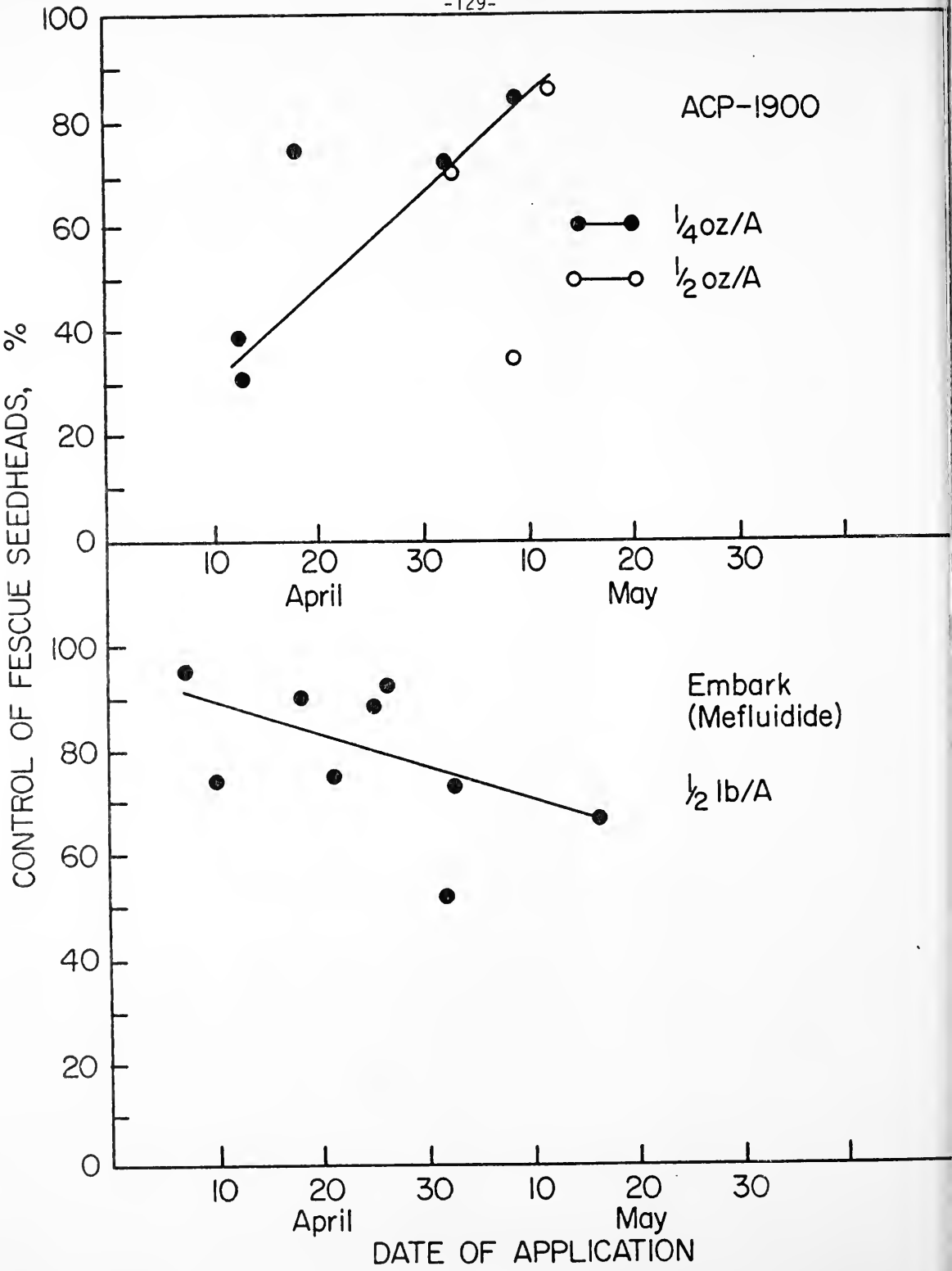
Appendix Fig. 8. Control of foxtail as a function of rate of application of Balan (Experiment 84-24; applied May 14, 1984) and Betasan (Experiment 84-27; applied May 27, 1984). Evaluations were on August 21, 1984. Since the material was not incorporated, it appears doubtful that Betasan was effective in the control of foxtail at any rate of application. Lbs/acre refer to pounds of active material added to the standard mixture of 1/4 lb/A Embark + 1/4 oz/A Telar + 2 lb/A 2,4-D amine + 0.25% X-77 surfactant (by volume). At 0 lb/A, only the standard mixture was applied.

Table 84. Embark plus Telar in the presence of surfactant and 2,4-D amine in combination with 0.3 or 0.5 lb/A of Poast or Poast alone on late fall growth and survival of fescue and bluegrass. IN-126 test area. Plots 3 ft X 6 ft. Application on August 29, 1984. Grass had been mowed. Fescue was 17 inches and bluegrass was 14 inches at the time of spraying. 40 gpa. 40 psi. Evaluation was on October 8, 1984. Averages from three replications ± standard deviations.

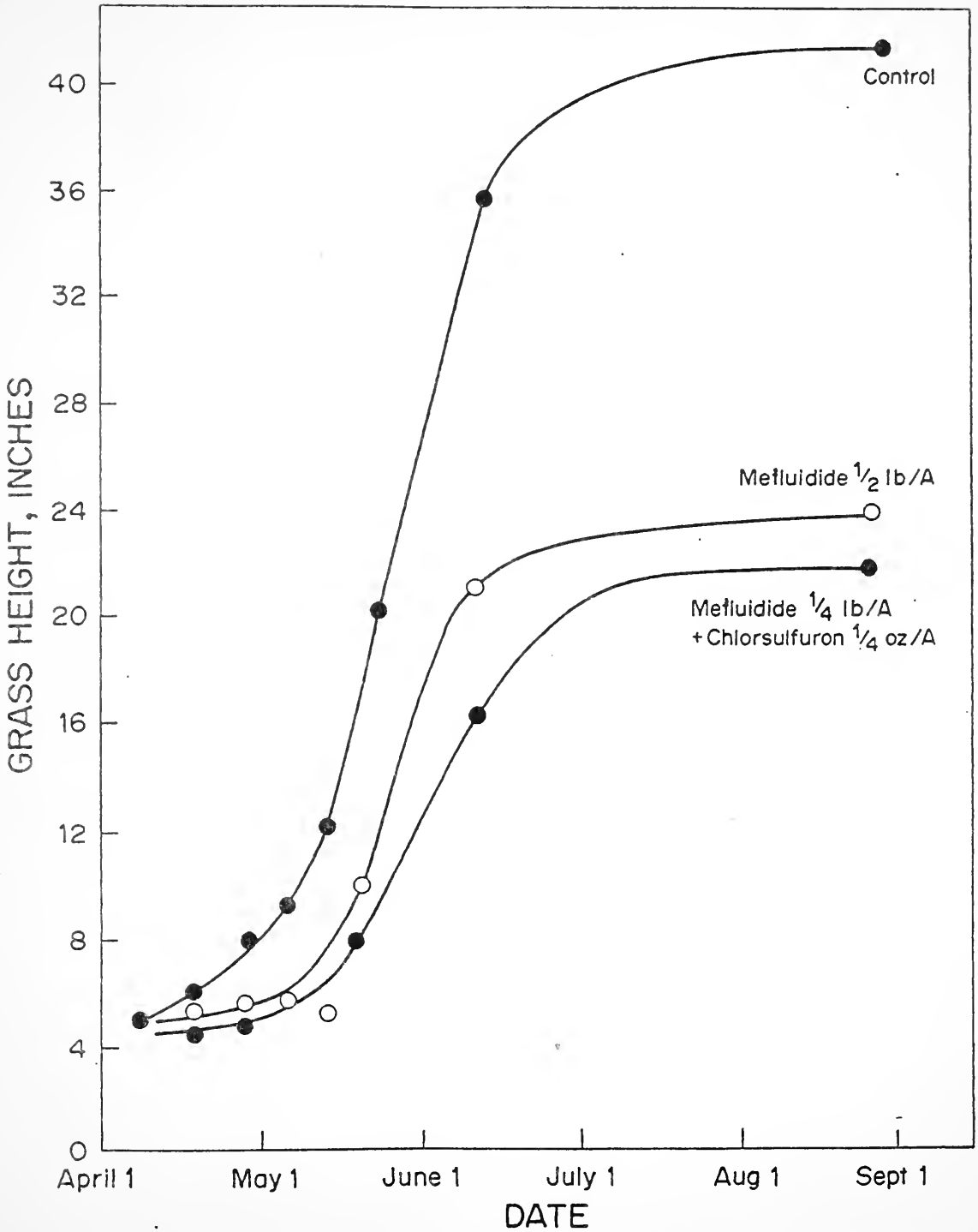
Amount*					Fescue
Embark	X-77	Telar	2,4-D amine	Poast	Grass Ht, Inches
1/8 lb	0.25%	1/8 oz	2 lb	0.3 lb	18 ± 3
1/4 lb	0.25%	1/4 oz	2 lb	0.3 lb	17 ± 1
1/8 lb	0.25%	1/8 oz	2 lb	0.5 lb	15 ± 1
1/4 lb	0.25%	1/4 oz	2 lb	0.5 lb	15 ± 1
-	-	-	-	0.3 lb	15 ± 1
-	-	-	-	0.5 lb	15 ± 1
-	-	-	-	0.75 lb	15 ± 1
-	-	-	-	1.0 lb	16 ± 1
-	-	-	-	2.0 lb	16 ± 1
-	-	-	-	16.0 lb	17 ± 1
-	-	-	-	-	20 ± 1

* amount per acre of active ingredient except for X-77 which is given as amount of the total spray mixture.

All treatments with Embark and Telar at either rate of Poast are indistinguishable. The grass seems to be alive but has not greened up. All rates of Poast look essentially equivalent and less damaging than Poast in the combination with Embark and Telar except for 16 lb/A of Poast which has already killed much of the fescue present.



Appendix Fig. 9. Percent control of fescue seed heads as a function of application date for Embark and ACP-1900.



Appendix Fig. 10. Growth suppression of fescue by the combination of 1/4 lb/A mefluidide + 1/4 oz chlorsulfuron (Telar) + 2 lb/A 2,4-D amine with X-77 surfactant as 0.5% of the total spray mixture (●) compared to the same conditions of 2,4-D and surfactant but with 1/2 lb/A of mefluidide instead (O). Applications were on April 17 under roadside conditions. IN-127 test area.

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